A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

NOVEMBER, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

4270. Structure of Matter. Part I. G. Fournier. *J. de Physique et le Radium*, 9. *pp.* 273–281, *July*, 1938.—Three-dimensional Euclidean space is divided into elements forming the domain of action of the particles of matter. Space is thus filled with matter and a geometrical framework constructed to define electron paths in atoms and in electron streams. H. G. C.

4271. Composition of Matter. R. Grégoire. *R.G.E.* 44. *pp.* 81–89, *July* 16, 1938.—Reviews the modern theories regarding the structure of the atom, the nature of isotopes and the properties of radioactive elements, leading up to a discussion of the mechanism of transmutation and a verification of the law of Lavoisier. E. O. T.

4272. Coulomb Energy of Light Nuclei. H. A. Bethe. *Phys. Rev.* 54. *pp.* 436–439, *Sept.* 15, 1938.—The Coulomb energy is calculated by determining the nuclear radius so that the energy difference between N^{13} and C^{13} agrees with observation. Two different assumptions are investigated: (*a*) that the nuclear radius is simply proportional to the cube root of the number of particles, (*b*) that the wave function of the last neutron or proton extends beyond the surface of the residual nucleus by an amount determined by its binding energy. The latter assumption accounts very well for the irregularities of the positron energies in the series $C^{11}N^{13}O^{15}F^{17}$, and agrees quantitatively with observation within 0·15 millimass-units. Theoretically and experimentally, the actual Coulomb energy should lie between the results of (*a*) and (*b*). Application of these considerations to unknown nuclei shows that C^{10} and O^{14} are highly stable, Be^{6} certainly and B^{9} almost certainly unstable, while the stability of B^{8} and N^{12} is doubtful. AUTHOR.

✱4273. Separation of Isotopes for Investigation of Nuclear Transformations. E. L. Yates. *Roy. Soc., Proc.* 168A. *pp.* 148–158, *Oct.* 10, 1938.—A mass spectrograph of simple design has been used to prepare deposits containing a few micrograms of the separated isotopes of Li, B and C. In the case of Li, a filament type ion source was employed, while the B and C ions were produced in a l.v. capillary arc running in BF_3 and in a mixture of CD_4 and He respectively. On examination in artificial disintegration experiments, the samples were found to be of high purity. AUTHOR.

4274. Extension of Periodic Table and Elements beyond Uranium. P. Ray. *Science and Culture*, 4. *pp.* 167–171, *Sept.*, 1938.—A brief account of the results of bombardment of the elements with α-particles, neutrons, protons and deuterons; and a somewhat more detailed summary of the results of Meitner, Hahn and Strassmann with uranium [see Abstract 3314 (1937)]. C. A. S.

4275. Hexacoordination in Telluric Acid, and in Molybdates and Tungstates in Solution. J. Gupta. *Indian Journ. Phys.* 12. *pp.* 223–232, *Aug.*, 1938.—Following a previous communication on the subject (*Nature*, 140. *p*. 685, 1937), telluric acid and several molybdates and tungstates have been examined by their Raman spectra in the crystalline state and in aqueous solutions of definite H-ion concentration. Theoretical and experimental evidence for the author's previous suggestion that in aqueous solutions, the normal molybdate and tungstate ions are present, like telluric acid, as dihydrated octahedral units, have been adduced. Extra lines recorded by other workers in solutions have been shown to be not due to vibrations of the normal molybdate or tungstate ions, but some of them are due to isopolycomplexes present in such solutions. AUTHOR.

4276. Valency and Covalency of Ruthenium in the Blue Chloride Solution. L. W. N. Godward and W. Wardlaw. *Chem. Soc., J.* *pp*. 1422–1424, *Sept*., 1938.—The blue solution resulting from the reduction of ruthenium trichloride has been reinvestigated. Four well-defined, new coordination compounds have been isolated by its interaction with certain amines under suitable conditions. In these compounds the metal is shown to be bivalent. As expected on theoretical grounds, they possess zero magnetic moment. AUTHORS.

4277. Maximum Valency and Atomic Structure. B. Ormont. *Acta Physicochimica*, 8. 6. *pp*. 811–847, 1938. *In German*.—The question of chemical compound formation is considered in a general manner from the point of view of stable electronic configurations and stable nuclear configurations, and the unsatisfactory character of all the valency theories so far advanced is emphasised. In particular, views are advanced as to the influence of electrons not formally involved in chemical links upon the valency angles in compounds. Further experimental investigations of the structure of compounds in which the valency is less than the maximum are considered to be desirable. [See Abstract 1416 (1937).] L. A. W.

4278. Deformation of Molecules in Condensed Phases and the Hydrogen Bond. E. Bauer and M. Magat. *J. de Physique et le Radium*, 9. *pp*. 319–330, *Aug*., 1938.—It is shown that the electrostatic perturbations of molecules by their neighbours permit the qualitative and in some cases quantitative explanation of the behaviour of the – OH group in different states of matter. The hypothesis of a homopolar H-bond is considered to be unnecessary, and the conception of a polar union is found to afford far better explanations of the frequency variations (*e.g.*, Raman and infra-red spectra) of the – OH radical as a function of temperature and physical state, and of relationship between solute and solvent. H. H. Ho.

4279. Estimation of Atomic Distances in Halides AX_3 and AX_4 by means of Electron Diffraction. O. Hassel and A. Sandbo. *Zeits. f. phys. Chem*. 41. *Abt.B*. 1. *pp*. 75–85, 1938.—Continuing earlier work [see Abstract 2652 (1938)], electron diffraction is used to investigate the molecular structure of halides of the fourth and fifth groups of the periodic table. The investigation gives new values for the distances of atomic separation, but these do not necessitate any fundamental alteration in the conception of molecular structure based upon the earlier work of Brockway and Jenkins [see Abstract 5344 (1936)]. The difference between the sum of the radii and the atomic distances in the Si compounds is striking, particularly with $SiBr_4$ and SiI_4. With regard to the problem of valency angles in the case of AX_3 molecules, it appears to be certain that of the corresponding As and Sb halides the As compound exhibits the larger

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angle. Further it seems probable that for halides of the same element the angle increases with increasing atomic weight of the halogen. A. G. Q.

4280. Scattering of X-Rays by Liquids, particularly Tertiary Aliphatic Amines. R. N. Bapat. *Zeits. f. Physik,* 110. 5–6. *pp.* 389–392, 1938.—The scattering of X-rays by $(C_2H_5)_3N$, n-$(C_3H_7)_3\cdot N$, n-$(C_4H_9)_3\cdot N$, iso-$(C_4H_9)_3\cdot N$, n-$(C_5H_{11})_3\cdot N$, iso-$(C_5H_{11})_3\cdot N$, iso-$(C_5H_{11})NH_2$ and iso-$(C_5H_{11})_2NH$ has been observed using a Shearer X-ray tube with a Cu target. The amine was placed in a circular hole in a glass plate sealed on either side with mica. From the position of the interference rings using the Bragg equation, " d " is calculated for each liquid and it is shown that the branched chain of the tertiary iso- compounds increases the linear cross-section of the molecule only when the hydrocarbon chain is short. F. J. L.

4281. Complexity of P_2O_5. A. Smits, J. A. A. Ketelaar and J. L. Meijering. *Zeits. f. phys. Chem.* 41. *Abt.B.* 2. *pp.* 87–97, 1938.—Vapour pressure measurements of the metastable form of P_2O_5 were carried out in glass and quartz apparatus in the temperature range of 260°–360° C. The vapour pressure is 0·4 to 1·7 cm.Hg. higher when determined in quartz apparatus. The vapour is unsaturated with respect to the metastable form but supersaturated with respect to the stable form: it also varies quite distinctly with regard to time. This variation is due to the transformation of the vapour on the walls, which transformation is catalysed by the walls, the glass having the greater catalytic effect. Vapour density determinations were made showing differences in the degree of association of the various forms. G. G.

4282. Complexity of Aluminium Chloride. A. Smits, J. L. Meijering. *Zeits. f. phys. Chem.* 41. *Abt.B.* 2. *pp.* 98–111, 1938.—An abnormal form of Al_2Cl_6 is obtained by the partial sublimation of the pure, very dry, salt. It shows an abnormally low vapour pressure and it is not stable, slowly changing to the ordinary form. This is explained by regarding the solid phase of Al_2Cl_6 as being composed of at least two pseudo-components. Sublimation and vapour pressure curves are obtained from which the position of the triple point can be found. Vapour-density determinations give the molecular weight as 271, while the theoretical value for Al_2Cl_6 is 267. G. G.

See also Abstracts 4301, 4450, 4464, 4530, 4660.

COLLOIDS.

4283. Nuclear Gold Sols. Part I. Determination of Particle Size. F. L. Usher. *Faraday Soc., Trans.* 34. *pp.* 1230–1233, *Oct.,* 1938. —A colorimetric method of determining particle size in nuclear gold sols is described, in which the colour scale is standardised by a sol whose particle size has been established by an independent method. The method is rapid in operation and suitable for routine measurements. Its accuracy is substantially that of the measurement used for standardising the colour scale. The colour of gold sols grown under proper conditions is, within the limits of accuracy of the measurements, strictly a function of particle size, and is independent of the reducing agent used when the latter is hydrazine hydrate, hydroxylamine hydrochloride, or hydrogen peroxide. AUTHOR.

4284. Colour and Nature of Solutions of Na in Liquid NH_3. F. Krüger. *Ann. d. Physik,* 33. 3. *pp.* 265–284, *Oct.,* 1938.—The following evidence is given in support of the view that solutions of Na in liquid NH_3 are colloidal. Calculation of absorption spectrum by the Mie theory, making simplifying assumptions and using uncertain values for the optical constants of Na, gives rough agreement with experiment. Ultramicroscopic investigations, although beset with experimental difficulties, reveal colloidal particles. It is found possible (by means of so-called "ultracella" filters) to filter off the blue part of the solutions, the filtrate having a much reduced electrical conductivity. It also appears possible to increase the life of the solutions by suitable protective colloids. L. A. W.

4285. Ferromagnetic Gels. T. Katsurai and K. Yamasaki. *Kolloid Zeits.* 84. *pp.* 311–314, *Sept.*, 1938.—Ferromagnetic gels were obtained by rubbing together $FeCl_3 \cdot 6H_2O$ and $Na_2SO_4 \cdot 10H_2O$, $MgSO_4 \cdot 7H_2O$, $MnSO_4 \cdot 5H_2O$, $NiSO_4 \cdot 7H_2O$, $CoSO_4 \cdot 7H_2O$, $ZnSO_4 \cdot 7H_2O$, $CuSO_4 \cdot 5H_2O$, $3CdSO_4 \cdot 8H_2O$, $HgSO_4$, and $(UO_2)SO_4 \cdot 3H_2O$, respectively. Treatment in an autoclave at 180° broke down the gels into two phases, the precipitate resembling neither haematite nor magnetite. A demonstration experiment which shows the difference in magnetic properties of iron hydroxides obtained in different ways is described. The colours of solutions of ferrous and ferric salts and their mixtures have been investigated photometrically. A. J. M.

4286. Thixotropic and Plastic Behaviour of Suspensions of Barium Sulphate with Clay. B. Tamamushi and Y. Sekiguchi. *Chem. Soc. Japan, Bull.* 13. *pp.* 556–565, *Aug.*, 1938. *In English.*—Nonthixotropic suspensions of $BaSO_4$ become thixotropic on adding certain amounts of a sodium-clay formed from a natural hydrogen-clay. The plasticity of the suspensions of $BaSO_4$ increases when the sodium-clay is added. The correlation among thixotropy, loose packing of particles (large volume of sedimentation), and isothermal plasticity, which is now generally accepted, is evident also in the systems under investigation. A characteristic influence of the particle size of $BaSO_4$ on the thixotropy and plasticity of the systems is mentioned. AUTHORS.

4287. Water-in-Oil Emulsions. Part I. R. C. Pink. *Chem. Soc., J. pp.* 1252–1254, *Sept.*, 1938.—Anhydrous and hydrated magnesium oleate have been prepared and examined. It has been shown that addition of small amounts of water to solutions of the anhydrous soap in benzene causes its precipitation in an insoluble form containing water. Such systems are not true emulsions, although appearing to be so. The results indicate that in the inversion of oil-in-water emulsions with magnesium chloride the magnesium oleate formed does not dissolve in the oil phase. AUTHOR.

4288. Conductivity Anomalies in Molecular and Colloidal Disperse Solutions. K. Hoffmann. *Kolloid Zeits.* 84. *pp.* 344–357, *Sept.*, 1938.—This very comprehensive paper deals with conductivity anomalies in 3 sections. Section (1) is devoted to the theory of conductivity anomalies and considers (*a*) anomalies based on interionic forces; (*b*) dissociation tension effects; (*c*) dipole effects; (*d*) influence of the nonhomogeneity of the medium. Section (2) records experimental investigations and results for strong and weak electrolytes with respect to (*a*) field effect and (*b*) frequency effect. Section (3) contains experimental data for colloidal systems with respect to the field and frequency effects. The paper includes 23 diagrams and a Bibliography of 61 references. H. H. Ho.

4289. Colloidal Structure of Rubber in Solution. S. D. Gehman and J. E. Field. *Indust. and Engin. Chem.* 30. *pp.* 1031–1036, *Sept.*, 1938.—The colloidal changes caused by the addition of precipitants to rubber solutions have been observed by measurements of viscosity and of the intensity and depolarisation of the transversely scattered light, as a means of securing information about the colloidal structure of rubber solutions. The light scattering measurements show that colloidal changes occur which are not apparent from the viscosity data. This is explained by the fact that the light scattering depends upon the geometry of the structure and the viscosity upon the potential energy in the structure. The results are considered to be further evidence that, in rubber solutions, the rubber molecules exist in clusters or groups, the size, shape, and " interlocking " of which depend upon the molecular forces in the solution. H. H. Ho.

4290. Optical and Dimensional Changes in Freezing and Melting of Rubber. W. H. Smith and C. P. Saylor. *Bureau of Standards, J. of Research,* 21. *pp.* 257–268, *Sept.*, 1938.—Microtome sections of frozen rubber were prepared and examined at controlled temperatures under a polarising microscope. The melting behaviour of both strained and unstrained sections of unvulcanised specimens, partially-vulcanised specimens and thin films was investigated. The effect of stress on the freezing of rubber was also studied, and the crystalline structure of frozen and stretched rubber is discussed. S. W.

4291. Crystallisation in Stretched Rubber. P. A. Thiessen and W. Wittstadt. *Zeits. f. phys. Chem.* 41. *Abt.B.* 1. *pp.* 33–58, 1938.—The conclusions found for rubber under pressure are found also to be valid for stretched rubber. [See Abstract 3454 (1938).] D. R. H.

See also Abstracts 4462, 4641.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

4292. Energy States of Valency Electrons in Metals. M. Satô. *Tohoku Univ., Sci. Reports,* 27. *pp.* 137–154, *July,* 1938. *In English.*—The selectivity of photoelectron transitions in the surface of Zn crystal was closely examined, and found to have an intimate relation with the direction of the oscillating electric vector of the exciting light. Further, applying the results obtained from the electrode potentials of the surfaces of Zn-single crystals, it was inferred that the selection rule, $\Delta l = \pm 1$, is explicable from the fact that the stability of orbital motion of the electron depends on the mutual orientation of the orbital plane and the electric vector of the exciting light. On the basis of this conception it was concluded that the orbital planes of p and d electrons in the energy levels, E_2 and E_3, in the surface layers of zinc crystals are perpendicular and parallel, respectively, to the axis [0001] of the crystal of this metal. [See also Abstract 1668 (1938).] AUTHOR.

4293. Cubical Atom Domains in the Crystal Structure of Metals. R. Reinicke. *Zeits. f. Instrumentenk.* 58. *pp.* 331–339, *Aug.*, 1938.—The use of spherical atoms in constructing models of the crystal structure of metals is criticised. It is suggested that the anomalies in such models can be avoided if cubical domains of action for the atoms are assumed. This procedure leads necessarily to the assumption of directed forces between the atoms. W. S. S.

4294. Statistical Theory of Superlattices with Long-Range Interaction. Parts I and II. J. S. Wang. *Roy. Soc., Proc.* 168A. *pp.* 56–77, *Oct.* 10, 1938.—In Part I Bethe's theory of order-disorder in superlattices is extended to cover the case of long-range interactions. The theory is applicable to any interaction energy of the form $V(r)$ subject to the condition $\int_0^\infty V(r)r^2dr$ = finite, and to a general class of lattice structures which include the three lattices of the cubic system. In Part II the general statistical theory is applied to the simple cubic lattice and the body-centred cubic lattice. It is shown that the assumption of an inverse power law for the interaction energy alters the calculated configurational energy in the direction required to make the agreement with experiment better than the assumption of interaction between nearest neighbours only, but the shift is not great enough to remove the discrepancy between theory and experiment completely. AUTHOR.

4295. X-Ray Study of Ag-Zn Alloys. E. A. Owen and I. G. Edmunds. *Inst. of Metals, J.* 63. [24 *pp.*], 1938. *Advance Copy.*—The phase boundaries in the Ag-Zn system below the temperatures of the β transformation have been determined by the X-ray method. All the boundaries in this region of the accepted equilibrium diagram require modification. The $(\beta + \zeta)$ phase field is found to be very narrow; its lower boundary reaches a minimum value at about 262° C. for an alloy containing about 65% Ag by weight. This temperature is lower than either of the β-transformation temperatures in the adjacent duplex regions. A survey is made of the positions of the phase boundaries in the Ag-Zn equilibrium diagram as determined by X-ray analysis. Attention is paid to the ζ phase, which is found to possess a close-packed hexagonal structure with 54 atoms to the unit hexagonal cell. AUTHORS.

4296. Structure of Electrolytic Lead Deposited from Nitrate Solutions. S. Yamamori and S. Yoshimoto. *Kyoto Coll. Sci., Mem.* 21. *pp.* 75–84, *July*, 1938. *In English.*—The arrangement of the micro-crystals in electrolytic specimens of lead, deposited from nitrate solutions was examined with X-rays by the Laue method. From the diffraction patterns obtained, it was confirmed that the micro-crystals of lead have a tendency to be electrolytically deposited in a fibrous way, with one of their [211] axes arranged parallel to a definite common direction, as was the case in the experiments previously made by other investigators with various electrolytes of different chemical composition. The present examination has shown, however, that in certain respects, conclusions drawn from previous experiments must be reconsidered; *e.g.*, the direction of the maximum growth of deposited lead and the relative orientation of the micro-crystals in the specimen. AUTHORS.

4297. Submicroscopic Twinning in Metals. F. Kirchner and H. Cramer. *Ann. d. Physik*, 33. 2. *pp.* 138–142, *Sept.*, 1938.—Irregular interferences in electron diffraction patterns are attributed to the existence of sub-microscopic twinning in the metal specimen, and on this foundation an investigation of the occurrence of twinning in metal films is carried out. Special attention is paid to the case of Ag condensed from the vapour on to heated rock-salt, and it is shown that with a mean Ag film thickness of 0·8 mμ no signs of twinning are observed. Twinning begins at about 2 mμ and it is well developed when the average film thickness is 20 mμ. Finally, the authors put forward an explanation of the processes which occur during the growth of metal films. A. G. Q.

4298. Polymorphic Transitions in Metallic Halides. R. B. Jacobs. *Phys. Rev.* 54. *pp.* 468–474, *Sept.* 15, 1938.—An X-ray powder analysis of RbI made at 4500 kg./cm². pressure and room-temperature shows the crystal form of RbI to be body-centred cubic under these conditions. The lattice constant is $4\cdot33_8$ Å. The volume change from the face-centred lattice, which is stable below 4000 atm., is $0\cdot037$ cm³. per gm.

This is about 0·009 cm^3. per gm. greater than Bridgman's piston displacement value and the difference may be significant. With the exception of the fluorides, all of the Rb and K halides undergo polymorphic transformations under pressure, which in the light of the present knowledge of RbI are assumed to be of the face-centred to body-centred type. The method of Born and Mayer is used to calculate the lattice constants for both face- and body-centred types of each halide at the experimentally known temperature and pressure of equilibrium. From these the volume changes of the transformation are computed. They are found to agree quantitatively with the experimental values. Theoretical values for the transition pressure are also given. These are confirmed by experiment only in a qualitative manner, but the method may be used to explain, for instance, the non-occurrence of transitions in the Na halides up to 50,000 atm. Similar calculations are made for AgI, the crystal form of which has been previously shown by the author to be face-centred cubic at pressures beyond 3000 kg./cm^2. AUTHOR.

4299. Order Versus Disorder in Ternary Structures Including Certain Spinels. F. C. Blake. *J. Chem. Phys.* 6. *pp.* 630–635, *Oct.*, 1938.—The doubling process as the second alternative suggested by M. v. Laue for mix-crystals is followed through in the case of lithium ferrite and it is shown in that case that all superlattice lines disappear when the lattice edge is eight times as large as the small disordered lattice found by Posnjak and Barth. It is shown that for this large (33 Å) lattice the *simple* space group, O_1^h, gives only face-centred lines on the powder photograph. The disappearance of the superlattice lines for this lattice may be said to be due to the coherence of the X-rays that cause the destructive interference involved. AUTHOR.

4300. Space-Group and Atomic Arrangements in Phloroglucine Dihydrate. K. Banerjee and R. Ahmad. *Indian Journ. Phys.* 12. *pp.* 249–258, *Aug.*, 1938.—An analysis of phloroglucine dihydrate by X-rays is described. The axial lengths are $a_0 = 6 \cdot 80$, $b_0 = 8 \cdot 103$ and $c_0 = 13 \cdot 70$ Å. The *okl* planes are absent when $k + l$ is odd and *hol* planes are absent when $h + l$ is odd. So the space-group is D_{2h}^{12} Pnnm. The density of the crystal is found to be 1·394 gm./cm^3., hence there are 4 molecules per unit cell. Molecular orientation in the crystal lattice is determined from considerations of magnetic anisotropy and space-group. AUTHORS.

4301. Structure of the Insulin Molecule. D. M. Wrinch and I. Langmuir. *Am. Chem. Soc., J.* 60. *pp.* 2247–2255, *Sept.*, 1938.—Crowfoot's data on X-ray reflections from insulin crystals [see Abstract 938 (1938)] as summarised in a set of Patterson-Harker vector maps, are found to correspond in great detail to the C_2 polyhedral structure predicted for the insulin molecule on the basis of the cyclol theory. The features of the insulin molecule confirmed by the X-ray data include: (1) six high density points at the corners of an octahedron of side 29·4 Å, which is the size given by the cyclol theory; (2) low density regions near the centres of the 44 lacunæ in the cyclol fabric that are located in definite positions in the edges and faces of the polyhedron; (3) a comparative hollow at the molecular centre, *i.e.*, a cage structure; (4) three Zn atoms per molecule on lines connecting molecular centres (except along the z-axis) and low and high density groups attached to these Zn atoms outside the C_2 structure. AUTHORS.

4302. Structure of Tricyanobromomethane. W. Fensch and G. Wagner. *Zeits. f. phys. Chem.* 41. *Abt.B.* 1. *pp.* 1–14, 1938.—Single crystals of the above compound are obtained by sublimation. An X-ray analysis gives the following results. The crystals are orthorhombic with $a = 6\cdot05$, $b = 11\cdot33$, $c = 17\cdot17$ Å; 8 mols. of $BrC(CN)_3$ per unit cell; density $= 1\cdot8$; space group $= D_{2h}^{11}$. The positions of the Br atoms are given by the co-ordinates $x = 0\cdot197$, $y = 0\cdot229$, $z = 0\cdot181$. It is probable that the group $C(CN)_3$ has the symmetry C_s. On the basis of these results the author puts forward a structure for the molecule $BrC(CN)_3$. J. I.

4303. Structure of Cyclohexane and Derivatives. O. Hassel and A. M. Sommerfeldt. *Zeits. f. phys. Chem.* 40. *Abt.B.* 5. *pp.* 391–395, 1938.—The structure of cyclohexane, which has a cubic lattice, is discussed and it is shown that at temperatures near the melting point the molecules possess free rotation. At lower temperatures a definite movement must also be supposed. The crystals of cyclohexanol ($C_6H_{11}OH$), cyclohexanon ($C_6H_{10}O$) and chlorcyclohexane ($C_6H_{11}Cl$) are cubic immediately below the melting point, and the molecules also rotate in these lattices. C. J. B. C.

4304. Diffraction of X-Rays in Organic Glasses. T. M. K. Nedungadi. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 65–72, *Aug.*, 1938.—Using a modified form of the ordinary X-ray diffraction arrangements, three organic substances, namely glycerin, salol and benzophenone have been investigated both in the liquid and glassy conditions by means of X-rays. The changes observed in the diffraction patterns when the liquid changes into glass are (1) a large decrease in the scattering at small angles with the primary beam, (2) a considerable sharpening of the haloes, and (3) a widening of the haloes. The first two effects have been explained by taking into consideration the large decrease in the compressibility of the substance as it changes from the liquid to the glassy state and the last one as due to the decrease of the intermolecular distance to form a closer packing of the molecules in the solid condition. AUTHOR.

4305. Double Refraction of Anisotropic Liquids. W. Kast. *Ann. d. Physik*, 33. 3. *pp.* 185–191, *Oct.*, 1938.—A large number of measurements of double refraction are given, and a discussion included of the molecular arrangements in the turbid melt compared to the order within the molecular swarm where the distribution is completely irregular. A certain reciprocal effect within the swarm, however, is indicated by the fact that the dispersion of light remains practically constant with increasing temperature, while the square of the double refraction decreases. An effect must also exist which compensates the decrease of light dispersion by the decline of double refraction, which can be explained by increase of orientation differences of neighbouring swarms with increasing temperature. The energy exchanges between the swarms is of the same dimensional order as the energy of the thermal movements. H. H. Ho.

4306. Calorimetric Measurements during Transition from the Anisotropic to the Isotropic Phase. C. Kreutzer. *Ann. d. Physik*, 33. 3. *pp.* 192–209, *Oct.*, 1938.—A differential method with full experimental details, and scheme of apparatus is first described for the direct measurement of the difference of specific heats and the heats of transformation from the anisotropic to the isotropic phases of para-azoxyanisole, para-azoxyanisole phenetole and para-azoxyphenetole. The specific heat in the isotropic phase is found to be smaller than in the anisotropic phase for all the above substances, a fact explained by the dense parallel packing of the long molecules in the latter phase, and the inner molecular changes. The heats of transformation were both qualitatively and quantitatively established, and found to increase with the size of the end-group, from which it is concluded that the minimum of potential energy for parallel arrangement of the molecules is lower according as the end-groups are greater. H. H. Ho.

4307. Field Strength Dependence of the Dielectric Constant of *p*-Azoxyanisole. W. Maier. *Ann. d. Physik*, 33. 3. *pp.* 210–225, *Oct.*, 1938.—A method for the measurement of the dielectric constant is described, which permits, at constant frequency, changes alone in the amplitude of the alternating field, so that the influence of the latter can be established. It is thus shown that the dielectric constant of *p*-azoxyanisole increases with increasing field strength. All the disturbing influences which have invalidated earlier measurements were carefully avoided. This effect is analogous to the well known influence of a longitudinal magnetic field, which produces a diminution of the dielectric constant. Since a magnetic field orientates the swarm axis parallel to the lines of force, the conclusion was drawn that the swarms transverse to this axis were more strongly polarisable than those parallel thereto. In the electric field, therefore, it was to be expected that there would be a transverse orientation of the swarms and an increase of the dielectric constant. This is discussed along with an alternative condition of rotation-hindering of the dipole molecules. H. H. Ho.

4308. Production of Long Single Crystals of Aluminium Drawn Wire. T. Fujiwara and T. Hudita. *Hirosima Journ. Sci.* 8. *pp.* 293–296, *Aug.*, 1938. *In English.*—Two methods of producing a long single crystal of metallic drawn wire by submitting it to mere annealing, without any stretching, etc., are described. AUTHORS.

4309. Low-Temperature Transformation of ND_4Br. Part I. A. Smits, D. Tollenaar and F. A. Kröger. *Zeits. f. phys. Chem.* 41. *Abt.B.* 3. *pp.* 215–235, 1938.—Pure ND_4Br was prepared and its transformations at low-temperatures studied dilatometrically. The transformation to the tetragonal from the cubic modification occurs at − 58° C. and exhibits hysteresis to an extent of about 0·15° C.; the corresponding transformation for NH_4Br is at − 39° C. The change in molecular volume is 0·06 cc. The further transformation found by Clusius, by using the polarisation microscope, was also found by the dilatometric method, but the hysteresis is about 9° C. The change in molecular volume is about 1·08 cm^3. and the crystals become cubic again. X-ray photographs of these two cubic modifications show they both have the CsCl structure and are completely identical A discussion on phase rule lines follows and it is pointed out that this is the first definite example of a "reverse transformation." These results, in contrast to those obtained with NH_4Br, are discussed in the light of the replacement of H by D. G. G.

4310. Nature of Excited Centres in Alkali-Halide Crystals. H. Wolff. *Zeits. f. Physik*, 110. 7–8. *pp.* 512–528, 1938.—Excited centres are produced in crystals of different degrees of purity. It is found that the number of excitable centres and the displacement of their absorption band as compared with the unexcited band increase with the impurity content. A similar displacement of the band can also be brought about by plastic deformation, and the maximum displacement which can be produced by impurities would correspond to a stress equal to the " ideal " strength of the crystal lattice. If the excited impure crystals are plastically deformed, there is no further red-shift of the absorption band. It is therefore concluded that the excited centres are always connected with places of high internal strain, produced either by impurities or by plastic deformation. R. P.

4311. Magnetic Anisotropy and Structure of $CuSO_4 \cdot 5H_2O$. Part II. K. S. Krishnan and A. Mookherji. *Phys. Rev.* 54. *pp.* 533–539, *Oct.* 1, 1938.—In Part I of this paper [see Abstract 5383 (1936)] were reported some magnetic measurements on the crystal of $CuSO_4 \cdot 5H_2O$. The crystal, though triclinic, has nearly uniaxial magnetic symmetry, and the symmetry axis is the direction of minimum susceptibility for the crystal. This observed uniaxial symmetry and the negative sign of the anisotropy were shown to follow naturally from the known fine structure of the crystal, and the direction of the symmetry axis also is nearly that predicted from the structure. In the present paper are described further magnetic studies on the crystal, and a more detailed correlation with its structure. The magnetic data are also discussed in relation to the magnitude and the asymmetry of the internal electric fields acting on the Cu^{++} ions in the crystal. A general method is described for determining, for any triclinic crystal, the principal magnetic axes and susceptibilities, *i.e.*, the constants of the magnetic ellipsoid. AUTHORS.

4312. Integration of Large Numbers of X-Ray Crystal Reflections. R. H. V. M. Dawton. *Phys. Soc., Proc.* 50. *pp.* 919–925, Nov. 1, 1938.—The experiments described show that if a positive film is printed from an X-ray negative, the change in the transparency of the former can be made directly proportional, over an extended range, to the intensity of the original X-ray beam. The transmitted light can, therefore, give the integrated X-ray value of a patch of non-uniform blackening without the necessity of a two-dimensional point-by-point integration. The application of this principle to X-ray analysis of crystal structure is discussed. AUTHOR.

See also Abstracts 4289, 4291, 4330, 4352, 4562, 4570, 4571, 4639.

DENSITY.

See Abstracts 4281, 4282, 4366, 4580, 4644, 4648.

DIFFUSION AND OSMOSIS.

4313. Diffusion of Water Enriched with H^2 and O^{17} through Dilute Gelatin Gel. N. Morita and T. Titani. *Chem. Soc., Japan, Bull.* 13. *pp.* 543–555, *Aug.*, 1938. *In German.*—The diffusion of water rich in $H_2^2O^{17}$ in dilute gelatin gels (about 5%) has been determined by two methods, which give 1·12 cm^2. per day and 1·83 cm^2. per day at 6°, respectively, for the diffusion constants. The true value lies between these limits. In both methods it was found that the O^{17} atoms diffused as rapidly as the H^2 atoms, and it is concluded that the additional diffusion of hydrogen atoms through their exchange with neighbouring H_2O molecules can be neglected in comparison with the ordinary diffusion of H_2O. A. J. M.

4314. Diffusion of Non-Electrolytes in Organic Liquids. O. Lamm. *Faraday Soc., Trans.* 34. *pp.* 1152–1158, *Sept.*, 1938.—This paper is a general discussion on formulæ relating the diffusion constant to the radius of the diffusing molecule and the viscosity of the solvent, etc.

A new approach to the question is given by starting from Andrade's formula for the viscosity of a monatomic liquid near the freezing point, and includes the use of Rayleigh's theorem. The general problem of viscosity and diffusion of binary mixtures is considered and both formulæ and results are given. The paper contains a large number of references.
E. H. D.

4315. Diffusion of Water in Glycerin. O. Lamm and G. Sjöstedt. *Faraday Soc., Trans.* 34. *pp.* 1158–1163, *Sept.*, 1938.—The method used was that known as the refractometric "scale" method which has previously been described in detail [see Abstract 824 (1930)]. Full details of the present experiments are given for diffusion, viscosity and density. Diffusion was found to be abnormally rapid, and this is explained as being due to non-existence of a bond between the water and the glycerin molecule, or to the fact that the diffusibility of the water is not determined simply by the viscosity of glycerin. E. H. D.

ELASTICITY AND PLASTICITY.

4316. Solution of the Fundamental Problems of Plane Theory of Elasticity in the Case of Contours with Corners. L. Magnaradze. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 673–676, 1938. *In English.*

4317. Theory of Plastic Stability and its Application to Thin Plates of Structural Steel. P. P. Bijlaard. *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 731–743, 1938.—[See also Abstract 3604 (1938)].

4318. Plastic Deformation of Pb, Cu and Al Under Static Compression. W. J. Lyons. *J. of Applied Physics*, 9. *pp.* 641–646, *Oct.*, 1938.—Creep in metals under constant load indicates that plastic deformation depends on the duration as well as the magnitude of the compressive force. The dependence of deformation on duration is significant in the lead crushers used in measuring pressures. Static compression tests on lead, extending over 30-min. periods, and under various loads up to 109 kg. have been conducted. The dependence of deformation on duration is found to be great under the higher loads, and much greater than the dependence in the case of Cu and Al, on which comparative tests were made. The deformation-compression-time relation is found to be approximately linear under constant pressure. The present data are in agreement with the results of Bogomolov and Kunin on lead for pressures in a higher range. However, the law derived by them does not hold in the pressure-range of the present tests. AUTHOR.

4319. Eigenwert Problems for the Rectangular Elastic Plate. S. Iguchi. *Hokkaido Imp. Univ., Eng. Mem.* 4. *pp.* 305–372, *Aug.*, 1938. *In German.*—Formulæ are obtained for the frequencies of the normal modes of transverse vibration of a rectangular elastic plate of uniform thickness, for each of the six possible combinations of edge conditions in which any edge is either simply supported or clamped. Graphs showing the variations with the ratio of the sides are given. The effect of direct and shear stresses applied to the edge, in the plane of the plate, is also considered, and critical values of these stresses are determined.
W. G. B.

4320. Fracture of Glass Plates by Percussion. T. Okaya and K. Ishiguro. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 540–546, *July*, 1938. *In French.*—In continuation of previous work [see Abstract 3885

(1937)], experimental results are discussed mathematically and expressions deduced connecting the coefficient of fracture with the angle of percussion. F. S.

4321. Self-Hardening as a Method for Increasing Strength of Glass. I. I. Kitaigorodsky. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 711–714, 1938. *In English.*—Compound sheets of glass have been formed, the outer layers being of quick hardening glass and the inner layers of slow hardening glass. Of two pairs of glasses, the results are found equal in mechanical strength to a commercial glass known as "securite." Coloured glass may also be made by combining layers of coloured and colourless glasses. F. S.

See also Abstracts 4339, 4576, 4602, 4723.

GRAVITATION.

***4322. Static Gravimeter for Measurements on Land and Sea. H. Haalck.** *Beitr. z. angew. Geophys.* 7. 3. *pp.* 285–316, 1938.—A detailed description is given of the latest type of gravimeter [see Abstract 4098 (1935)] with the theory of the instrument, method of use, source of errors and precautions to be observed for their avoidance. The accuracy attainable is on land ± 1 m.gal. and on sea (if reasonably smooth) ± 1–5 m.gal. C. A. S.

HYDRODYNAMICS AND AERODYNAMICS.

4323. Turbulence of an Air Current. K. Kitagawa. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 586–589, *July,* 1938.—The magnitude of the dispersion produced by the turbulent convection of an air current is proportional to the space covered. It is shown that this statistical relation corresponds with that found for the draining of subterranean water [see Abstract 2281 (1936)]. N. M. B.

4324. Drag Coefficient of Plate in Steady Stream. T. Okaya. *Phys. Math. Soc. Japan., Proc.* 20. *pp.* 625–635, *Aug.*, 1938. *In French.*—An approximate value of the drag coefficient of a thin plate placed in a steady stream of viscous fluid is obtained in terms of characteristic incomplete gamma functions and of characteristic functions of the probability integral. J. S. G. T.

4325. Flow of a Compressible Fluid Past a Circular Cylinder. I. Imai. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 636–645, *Aug.*, 1938. *In English.*—An analysis of the flow of a uniform stream of compressible fluid past a circular cylinder is carried out to a second order of approximation by a method similar to that used by Janzen and by Rayleigh, who found solutions to a first order of approximation only. The second-order correction, arising from compressibility of the fluid, contains terms involving γ (the ratio of spec. heats) and terms independent of γ. The results are in good agreement with Taylor's observations [see Abstract 382 (1929)]. J. S. G. T.

4326. Forces on Two Spheres Placed in Uniform Flow. D. Endô. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 667–703, *Aug.*, 1938. *In English.*—The velocity potential for the flow past two fixed solid spheres is found in terms of the bipolar coordinates in three dimensions. Coefficients in it must be determined successively because it seems difficult to obtain their general expressions. In the special case when the flow is parallel to the central line, the stream function can be used and the coefficients in it can wholly be determined. Then the resultant fluid pressures on the spheres are calculated and discussed numerically. Most of the results are quite similar to the case of two circular cylinders except the magnitude of the limiting critical angle. Finally the integral formulæ used in the text are given in an Appendix, as well as the tables of Legendre functions and their derivatives for arguments greater than unity. AUTHOR.

4327. Transition from Laminar to Turbulent Flow in the Boundary Layer of a Sphere. S. Tomotika and I. Imai. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 167. *pp.* 389–423, *Aug.*, 1938. *In English.*—The momentum integral equation for the boundary layer on a surface of revolution is applied to the case of the boundary layer of a sphere placed in a uniform stream; the flow in the boundary layer is assumed to be laminar and the velocity distribution in the layer is given by a quartic expression. The differential equation determining the thickness of the laminar boundary layer is solved graphically in each of 3 cases, *viz.*, for values of the Reynolds number (1) just within, (2) near the middle of, and (3) above, the critical range. In case (1) satisfactory agreement is found between theory and Fage's experimental results. In case (2) it appears that transition from laminar to turbulent flow in the boundary layer begins at a point near that of minimum pressure. In case (3) the transition begins at a point in front of the point of minimum pressure. The critical value of the Reynolds number is about 1450. J. S. G. T.

4328. Theory of Turbulence. C. Ferrari. *Accad. Sci. Torino, Atti,* 73. *Disp. 3a. pp.* 373–396, *April–June,* 1938.—The statistical theory of turbulence, due to v. Kármán, is extended and applied to a number of problems, including damping and the correlation of velocity components. W. A. R.

4329. Use of a Vertical Pipe as an Overflow for a Large Tank. A. M. Binnie. *Roy. Soc., Proc.* 168*A*. *pp.* 219–237, *Oct.* 25, 1938.—The performance of vertical pipes arranged as overflows in a tank was studied experimentally on a small scale with special apparatus, which ensured that the water reached the pipe inlet with no tangential component of velocity. Under normal conditions, the change of head with discharge was small at low heads. At this stage the flow was not rotational, but a considerable volume of air was drawn down the pipe in the form of bubbles. Above a sharply marked critical head, the pipe ran full and a large rise of head caused only a slight increase in the discharge. The effects on the critical head of lengthening the pipe and of sharpening its inlet end were comparatively small, but the insertion of a trumpet-shaped mouthpiece greatly improved the performance. The types of flow described by Borda as free and full flow were possible with overflow pipes of uniform diameter, and they resulted in a serious reduction in the discharge. AUTHOR.

See also Abstracts 4578, 4591.

KINETIC THEORY OF MATTER.

4330. Free Volumes and Free Angle Ratios of Molecules in Liquids. J. F. Kincaid and H. Eyring. *J. Chem. Phys.* 6. *pp.* 620–629, *Oct.*, 1938.—The free volume is defined as the total integral over that part of the potential energy of the molecule in the liquid which is due to thermal displacements of the centre of gravity of the molecule from its equilibrium position. The free angle is the corresponding integral over angular displacements of the molecule. The free volume, V_f is related to the velocity of sound, u, in the liquid by u (liquid) $= u$ (gas) $(V/V_f)^{1/3}$. This equation is used to derive a formula connecting the sound velocity in the liquid with its thermal conductivity. The quantity, $RT/p \exp (\Delta H/RT)$, gives the *product* of the free angle ratio and the free volume, rather than the free volume itself. Here p is the vapour pressure and ΔH is the heat of vaporisation. The free volumes from sound velocities agree with those determined by independent methods. Specific heats, entropies of vaporisation, the spectroscopic observations of Cartwright, and the differences between sound velocity, free volumes and the function $RT/p \times \exp (\Delta H/RT)$ are examined from the point of view of restricted rotation of the molecules in liquids. Lack of free rotation of molecules suffices to explain the abnormalities of the liquids examined. The dielectric constants of polar liquids are interpreted assuming restricted rotation and the following formula is derived: $\mu_l^2\mu_g^{-2} = 1 - ((1 + \cos\theta_1)/2)^2$, where μ_l is the apparent dipole moment of the molecule in the liquid, μ_g is the dipole moment as determined from measurements in the gas phase, and θ_1, is the polar angle related to the free angle ratio, δ_2, by $\delta_2 = (1 - \cos\theta_1)/2$. The concept of restricted rotation of the molecules in the liquid accounts satisfactorily for the observed dielectric polarisations of water and methyl alcohol. AUTHORS.

4331. Determination of the Cross-Section of Metastable He Atoms with the Aid of Their "Photoelectric" Effect. R. Dorrestein and J. A. Smit. *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 725–730, 1938.—A method is described by which the cross-section of metastable He atoms for collisions with normal He atoms is determined by measuring the intensity decrease of a beam of metastable atoms in He of low pressure. The relative number of metastable atoms is measured with the help of the electrons they liberate from a metal surface. AUTHORS.

LENGTH, AREA AND VOLUME.

***4332. Precision Measurements with the Micrometer Eyepiece. H. Rühle.** *Zeits. f. Instrumentenk.* 58. *pp.* 355–374, *Sept.*, 1938.—The author is concerned with the errors which arise in setting the cross-wire of a micrometer onto the edge of a luminous object, due to contrast effects in the eye. In the experiments the luminous " object " consisted of the image of an illuminated aperture, formed by a telescope objective. The actual size of the image was determined by calculation and compared with the apparent size given by the micrometer settings. The variations of the error with object brightness and exit pupil size were determined. The results are interpreted, taking into account the contrast sensitivity of the eye and the " grain " of the retina. W. S. S.

***4333. Divided Circles. W. Krug and H. Oehler.** *V.D.I.* 82. *pp.* 797–804, *July* 2, 1938.—A review of the problem and present solution of the manufacture of divided circles, such as are required in many types of instrument, such as theodolites. The line of present research is indicated together with an illustrated description of calibrating and measuring plant, including an automatic divider. The question of making masters for multiple work is also discussed. L. E. C. H.

***4334. Optical Spherometer for Non-Reflecting Surfaces. C. S. Venkateswaren.** *Zeits. f. Instrumentenk.* 58. *pp.* 321–323, *Aug.*, 1938.—The device consists in placing two exactly similar optically flat mirrors in contact along one edge, each mirror being in contact also with the spherical surface. The angle between the two mirrors is then measured with an autocollimating telescope fitted with a micrometer. W. S. S.

See also Abstract 4644.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

4335. Operational Forms and Contour Integrals for Struve and other Functions. N. W. McLachlan. *Phil. Mag.* 26. *pp.* 457–473, *Oct.*, 1938.

***4336. Measurement of Angles. C. Schmerber, P. Tardi and P. Caillol.** *Bull. géodésique, No.* 56. *pp.* 290–295, *Oct.–Nov.–Dec.*, 1937.—It is pointed out that with modern instruments employing filar micrometer eyepieces, there is no reason why the angles in a fundamental triangulation should not be measured by the repetition method, rather than by the reiteration method now in use. A method of "fractional repetition" which avoids intermediate microscope readings is described for use with a reiterative instrument, and its advantages over the present method are outlined. The construction of an azimuth circle for testing the method is described, with a numerical example as illustration. A. Hu.

4337. Use of Probability Paper. E. W. H. Selwyn. *Phys. Soc., Proc.* 50. *pp.* 914–918, *Nov.* 1, 1938.—The method of plotting observations on probability paper becomes clear when the curve on probability paper is regarded as an integral of the histogram. The observations are divided into intervals, which may often conveniently be the natural interval of measurement, and the total frequency of observations up to and including the *n*th interval is plotted against the upper end of the *n*th interval. It is shown that in drawing a straight line to fit the observations, less weight should be attributed to deviations from the line towards its ends than in the middle regions. AUTHOR.

4338. Coordination of Units of Measurement. M. Simonoff. *Univ. Nac. La Plata, Publ. No.* 116. *pp.* 5–24, 1938.—From a critical discussion of μ and ϵ in e.s.u. and e.m.u., the author concludes that the divergence proves that magnetic mass should be interpreted as the quantity of movement of electric mass. He would establish a system based on the provisional interpretation of magnetic mass, and replacement of material mass M by electrical mass M_e ($M^{\frac{1}{2}} L^{\frac{1}{2}}$). From the failure of attempts to homogenise units of the same type in different systems based on the Newtonian law, he would define mass in terms of acceleration, eliminating it between the fundamental units. He considers the two-dimensional (L,T) Newtonian system as absolutely and universally true, and classifies collections of bodies or masses according to Newton's law, using local units. The new units may also be applied to the planetary system, "terrestrial" units being based on the acceleration due to gravity and the mean density of the earth, planetary local units being derived similarly. Planetary mass is tabulated in relation to other characteristics. Local systems based on solar attraction and the moments of planetary mass allow the "planetary day" to be defined and the sidereal period to be determined in terms of local days. The planetary years for Mercury, Mars, Jupiter, Saturn, Uranus and Neptune, expressed in this way, all lie between 361·72 and 362·72, that of the earth is 365·26, and of Venus 395·76. Fusion of the electrostatic and electromagnetic systems without recourse to hypothetical dimensions for μ and ϵ, as also the definition of the true character of metric systems based on Newtonian mechanics, is yet wanting. D. R. H.

See also Abstracts **4577**, **4579**, and
3184B. Notion of an Angle. E. Brylinski.

MECHANICS, CLASSICAL.

4339. Mechanics of Elastic Collisions. Parts II and III. C. Cattaneo. *Accad Lincei, Atti*, 27. *pp.* 434–436, *May* 1, *and pp.* 474–478, *May* 15, 1938.—Continuing previous work [see Abstract **3523** (1938)] in which the tangential components of the local forces in the region of contact of two elastic bodies colliding obliquely was dealt with, a determination is now made of the normal component over the whole area σ of the contact. The author then discusses the procedure for applying his equations, which are only strictly valid for a smaller area σ^*, to the whole area σ of the contact for the determination of the tangential action. In Part III the actual determination is given. G. G.

4340. Graphical Arrangement of Accelerations of Points of Plane Figure in its own Plane. M. Manarini. *Ricerche di Ingegneria*, 6. *pp.* 66–74, *May–June*, *pp.* 119–125, *July–Aug.*, 1938.—A wide study is developed on the graphical arrangement of the accelerations in the plane of motion of a rigid system by deducing, by the unitary method, laws that complete those already known. For every straight line of the moving plane there is established the existence of a succession of straight lines, and of circumferences related to the same, with which is strictly connected the graphical determination of the accelerations of the respective points. Particular cases are considered. J. J. S.

***4341. Variable-Length Pendulum. M. Zeuli.** *Accad. Lincei, Atti*, 27. *pp.* 444–450, *May* 1, 1938.—Another method to investigate Lecornu's approximate solution and its limits of error. W. A. R.

4342. Distribution of Mass, Velocity, Momentum and Energy of Broken Pieces of Exploded Bodies. Part III. S. Suzuki and H. Nagasima. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 517–539, *July*, 1938. *In English.*—The study is made of the distribution of the broken pieces of balls of chalk and plaster of Paris, when they are exploded at their centre. The frequency-distribution of the velocity of the broken pieces of both materials follows rather closely Maxwell's law, while those of the mass, momentum, and energy behave quite differently and increase with their decrease according to the following equation, $y = (A - B \log x)^2$. The broken pieces are divided into two groups. One contains the larger pieces and probably follows Maxwell's law of distribution, whereas the other contains smaller pieces and follows a so-called pseudo-hyperbolic distribution. The correlation is most intimate between mass and momentum, less between mass and energy, and least between mass and velocity. All of the broken pieces revolve around their own axis, with a very few exceptions, and the angular velocity, which frequently appeared, is of the order 50 r.p.s. [For Parts I and II see Abstracts **1263** and **4544** (1936).] See also *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 828. *pp.* 1086–1122, *Oct.*, 1938. *In English.* AUTHORS.

4343. Geometrics in Euclidean Space. R. de Saussure. *Arch. des Sciences*, 20. *pp.* 117–122, *May–June*, 1938.—A summary of the views on geometry and the conclusions arrived at by the author in a series of papers published over the years 1898 to 1921. N. M. B.

See also Abstract **4644**.

MECHANICS, QUANTUM.

4344. Elementary Demonstration of the Wentzel-Brillouin Method. E. Persico. *N. Cimento*, 15. *pp.* 133–138, *March*, 1938.—It is shown that the method of Wentzel and Brillouin which combines the Sommerfeld quantising condition with wave mechanics, may be put into a simple didactic form, that makes direct appeal to intuition and avoids the use of higher mathematics. C. J. B. C.

4345. Limits of Applicability of the Present Quantum Theory. W. Heisenberg. *Zeits. f. Physik*, 110. 3–4. *pp.* 251–266, 1938.—The quantum theory of wave fields, developed in a manner in which the relativistic invariant characteristics of the theory are clearly recognisable, necessitates the postulation of two natural hypotheses relating to limits within which application of the present quantum theory is justified. The one assumption is contained in the statement that a process can be treated in accordance with the formulæ of quantum mechanics only when for each particle at every point of time of the process, a time interval, $\Delta t \gg r_0/c$, can be specified such that during this interval the particle experiences no change (r_0 in the expression being of the order of magnitude of the classical electronic radius, *viz.*, $2{\cdot}81 \times 10^{-13}$ cm.). The hypotheses are applied to the discussion of special cases, *e.g.*, the motion of protons and neutrons in the nucleus, the diffraction of waves by a lattice in which the hypotheses are satisfied, and to the case of β-disintegration, in which the hypotheses are not satisfied. J. S. G. T.

See also Abstracts **4348, 4349, 4453, 4545, 4721.**

PRESSURE.

✱4346. Simple Safety Sealing Device for High-Vacuum Pumps. K. Seiler. *Zeits. f. techn. Physik*, 19. 9. *pp.* 283–284, 1938.—A mercury switch is used in the present device as follows: The overflowing cold water flows into a glass vessel which is fixed below an outlet. The vessel hangs at one end of a balance beam, on the other side of which the three-pole mercury switch tube is fixed, together with a definite counterpoise weight. Behind the switch a switch-board is fixed, to which the three leads from the mercury switch are taken and fixed. Two knife-edge fulcrums are fixed on the board also to carry the balance beam. The counterpoise weight is so adjusted that when the glass vessel on the outflow circuit is filled to a certain point, the balance beam rotates and short-circuits the correct poles of the mercury switch. The device is such that a warning lamp can be brought into circuit if the vacuum pump is not working effectively and also shuts out the current effectively thus sealing the vacuum. This happens as soon as the overflow tube is filled to the desired height. S. G. B.

See also Abstracts **4318, 4644, 4664.**

RELATIVITY AND ETHER.

4347. Criticism of the Special Theory of Relativity. A. Eagle. *Phil. Mag.* 26. *pp.* 410–414, *Sept.*, 1938.—The author arbitrarily regards the synchronisation of clocks by means of light-signals as "erroneous." He points out that if clocks are synchronised instead by means of rigid driving-rods connecting the clocks, the "time" kept by such clocks will not be the " time " envisaged in the Lorentz transformations of special relativity. G. C. McV.

4348. Eddington's World-Theory. E. Schroedinger. *N. Cimento*, 15. *pp.* 246–254, *April*, 1938. *In French.*—A short summary of Eddington's recent work on the unification of relativity and quantum theory is given. The importance of the finiteness of space and of Eddington's " threshold " level of energy for the state of a primitive material particle are emphasised. The difficulty that Eddington's theory implies complete degeneracy of the material content of the universe together with very low average density is not, it is suggested, insurmountable. G. C. McV.

4349. Generalisation of Relativity Transformations. G. Wataghin. *Comptes Rendus*, 207. *pp.* 421–423, *Aug.* 22, 1938.—An examination has been made previously [see Abstract 4170 (1938)] of the formalism of the quantum theory, which is based on the hypothesis of the existence of new limitations to our possibility of defining and measuring physical magnitudes, and of a new indetermination in the domain of impulses possessing very large relative energies. In the present paper the author attempts to show that the existence of these limitations necessitates the generalisation of the group of transformations which constitute the basis of relativity. It is found that the unitary transformations which substitute and generalise the relativity transformations (by promoting the passage from one measuring arrangement to another) also transform the subdivision of the phase space into a finite number of quantum cells relative to a corresponding reference system. H. H. Ho.

4350. New Systems of Normal Coordinates for Relativistic Optics. G. Temple. *Roy. Soc., Proc.* 168A. *pp.* 122–148, *Oct.* 10, 1938.—This paper develops the theory of a new system of normal coordinates (y^μ) in an n-dimensional manifold with an indefinite metric of signature $+1-(n-1)$. In this system of coordinates the expression for the metric has the form $ds^2 = h_{jk}dy^j dy^k + 2dy^{n-1}dy^n$, $(j, k = 1, 2, \ldots, n-1)$. Any arbitrary time-like curve C being taken as the base curve, the forward null cone at any point A on C is given by $y^{n-1} = \text{constant}$, C itself is given by the single equation $y^n = 0$, and any forward null geodesic G from A is given by $y^j = \text{constant}$ $(j = 1, 2, \ldots, n-1)$. y^n is the " projected length " defined in a general coordinate system (x^μ) by $y^n = \int K_\mu dx^\mu$, where the integral is taken along G from A, and K_μ is a unit vector transported along G by parallel displacement and forming the tangent to C at A. Hadamard's theory of null geodesics as bicharacteristics leads to a generalisation of this system of normal coordinates in which $y^{n-1} = \text{constant}$ is the equation of a system of wave fronts, $y^j = \text{constant}$ are the equations of the orthogonal null geodesics or rays, and y^n is a projected length measured along the rays. The theory is applied to optical problems in general relativity. Fermat's principle of minimum time is established rigorously for any relativistic manifold. The discussion of astronomical determinations of distance is simplified by the use of the new system of normal coordinates, which gives explicit expressions for the various distance functions. These general results are illustrated by the case of a manifold representing an isotropic expanding universe. Incidentally the use of normal coordinates of Riemann's type in relativistic optics is justified by a new definition in terms of " projected distances".

AUTHOR.

See also Abstracts 4380, 4381, 4470.

SOLUTION.

4351. Interaction between Solutes and Polar Solvents. W. J. Dunning and W. J. Shutt. *Faraday Soc., Trans.* 34. *pp.* 1192–1202, *Oct.*, 1938.—The solubilities at 25° C. of $PbCl_2$ in water and in aqueous solutions of glycine and urea have been determined. It is shown that the results qualitatively obey the Born equation relating solubility with dielectric constant of the solvent. The ionic radius, calculated with the aid of this equation, is probably in error owing to the impossibility of correcting adequately for the ionic interaction energy in solutions so concentrated as saturated $PbCl_2$. The solubilities of AgCl have been determined in the same media using a special method depending upon electrometric titration. The solvent-solute interaction energy has been calculated and a value for the mean ionic radius computed. The solubility of glycine in aqueous solutions of urea has been determined. The saturation concentration of glycine (moles per litre) decreases with increasing concentration of urea, but the solubility of glycine referred to water alone (gm. glycine per 1000 gm. water) remains practically constant for urea concentrations between zero and five molar. This difference between the solubility relations of zwitterions and those of simple ions is interpreted in terms of the shorter range of the electrostatic forces around the zwitterions. AUTHORS.

4352. Non-Aqueous Solutions. V. A. Plotnikov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 707–710, 1938. *In English.*—A catalogue of some of the properties of non-aqueous solutions. The formation of large molecular aggregates (quasi- or fore-crystals) in *e.g.* a solution of KBr and $AlBr_3$ in C_6H_6 is discussed, and the term " ionising tendency " or " dissociating power " criticised. Crystallisation of $AlBr_3$ from a C_2H_5Br solution, and of acetamide from a bromine solution, both solutions having considerable electrical conductance, is taken to indicate that other compounds are precipitated on crystallisation than those which are present in solution. F. J. L.

See also Abstracts 4278, 4638.

SURFACE PROPERTIES.

4353. Duration of Energy Interchange between Gas-Molecules and a Solid Surface. W. Hunsmann. *Zeits. f. Elektrochem.* 44. *pp.* 606–610 : *Disc.*, 610, *Sept.*, 1938.—It is shown that the thermal accommodation coefficient α can be represented by $\alpha = \tau/(\tau + \beta)$, where τ is the mean absorption-time, or time of stay of a gas molecule on a surface, and β the time in which its temperature alters by $1/e$ of the difference between its initial temperature and that of the surface. Since α and τ can be experimentally determined it becomes possible to derive values for β. This is done for reactions between the gases SF_6, N_2O and C_2H_6 and surfaces of quartz and of oxidised Ni over the range $-100°$ to 100° C. For the latter surface values of from 10^{-8} to 10^{-9} sec. are obtained for β, but for quartz the values are 20 to 50 times smaller. This result agrees with the predictions of Herzfeld and Mayer [see Abstract 3981 (1931)]. R. W. P.

4354. Thermal Properties and Heats of Adsorption of Films on Vitreous Silica. W. G. Palmer. *Roy. Soc., Proc.* 168 *A. pp.* 190–206, *Oct.* 25, 1938.—Isothermals have been obtained at temperatures between 70 and 25° for adsorption of the vapours of benzene, acetone and methyl alcohol on known surfaces of vitreous silica, by methods giving a check on the constancy of the surface condition. The values of the coefficients of thermal expansion, compressibility and the temperature variation of the lateral force have been calculated and discussed in relation to parallel properties of the bulk phase. The heats of adsorption have been calculated from the temperature variation of the adsorption potential. Their relations to the fraction of surface covered are in agreement with theoretical predictions for films with interaction energy. AUTHOR.

4355. Surface Activity of Aqueous Solutions of Organic Ions with Hydrophobic Groups. Y. Mutô. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 646–652, *Aug.*, 1938. *In English.*—Organic ions with hydrophobic groups have a tendency to be adsorbed at a surface on account of those groups: their electric charge tends to force them out of the surface. It is conceivable then that the surface activity of aqueous solutions with hydrophobic groups will be increased by the addition of inorganic salts or, in general, strong electrolytes. The equation of adsorption of such ions is determined theoretically when the adsorbed amount is (1) small, (2) large. J. S. G. T.

4356. Adsorption of Metal Ions at Metal Surfaces. O. Erbacher. *Zeits. f. Elektrochem.* 44. *pp.* 594–598; *Disc.*, 598, *Sept.*, 1938.—By simple exchange of metal atoms and baser ions at a metallic surface it is possible to determine the absolute surface of metals after different pre-treatment. Knowing this, the equivalent adsorption of ions in the system metal-baser ions can be determined. In the case of Pb ions adsorbed on Ag, Ni, or Au, the general adsorption isotherm holds. Over a range of 60° the mass of ions adsorbed was found to be independent of temperature, and approximately the same as in all metal-base kation systems investigated up to the present. This is only true, however, if the concentration of the base kations in the solution is sufficiently great to cause more than half the metal surface to be covered. In addition to primary adsorption where the adsorption of kations is accompanied by an equivalent exchange of anions, a secondary adsorption was observed. A. J. M.

4357. Adsorption of Colloidal Graphite from Oleosols at Metallic Surfaces. F. Pavelka and A. Wischin. *Kolloid Zeits.* 84. *pp.* 334–339, *Sept.*, 1938.—It is concluded that an iron surface had adsorbed graphite after treatment with a graphite oleosol from that change of its surface tension with respect to a mineral oil. This alteration in surface tension was only clearly established when the action of the oleosol had been prolonged or when the viscosity of the oleosol had been strongly reduced by dilution. A suitable diluting agent was petroleum and at 1 : 1 the surface tension of the iron was found to have altered after 15 hours' treatment. Full experimental details and a discussion of their theoretical basis are included. H. H. Ho.

4358. Activation of Charcoal. F. E. Bartell and L. E. Lloyd. *Am. Chem. Soc., J.* 60. *pp.* 2120–2125, *Sept.*, 1938.—Preferential adsorption from benzene-ethanol solutions by charcoals activated at different temperatures and in different gases shows that charcoal can be changed from extremely organophilic charcoal to charcoal approaching in adsorptive properties the hydrophilic adsorbent, silica. The characteristic S-shaped preferential adsorption curves for a series of increasingly hydrophilic charcoals have been plotted, and the points where these curves cross the X-axis, the X_0 values, are shown to be a measure of the relative organophilic or hydrophilic nature of the charcoals. The organophilic "high temperature charcoal" (activated at temperatures near 1000°), when suspended in water, gave both positively and negatively charged particles. This charcoal gave acid, but no base, adsorption. The less organophilic "medium temperature charcoal" (activated at temperatures near 400°), when suspended in water, gave only negatively charged particles and base adsorption. The "low temperature charcoal" (activated in a highly oxidising atmosphere below 150°), approaching in adsorptive properties hydrophilic silica, when suspended in water, gave only negative particles. It showed both acid and base adsorption. AUTHORS.

4359. Surface Tension of Vitreous Enamel Frits. W. N. Harrison and D. G. Moore. *Bureau of Standards, J. of Research,* 21. *pp.* 337–346, *Sept.*, 1938.—A method is described for measuring at high temperatures the surface tension of liquids with viscosities as high as 10,000 poises. It consists of weighing the portion of the liquid supported by the meniscus adhering to a Pt cylinder, the bottom edge of which is at the level of the undisturbed surface of the liquid. The method insures a zero angle of contact and eliminates the necessity of determining the specific gravity of the sample at the temperature of test. Results were in good agreement with those obtained by the bubble-pressure method on molten NaCl and also on a molten " soft " ground-coat frit at a viscosity of 400 poises. The results obtained on eight typical commercial vitreous enamel frits at 850° C. showed, with one exception, maximum differences of less than 10%. The mean value for seven of the frits was approximately 250 dynes/cm., while that for a high lead composition was about 200 dynes/cm. The surface tension in all cases increased with decreasing temperature between 925° and 775° C., the maximum increase being less than 10%. Mill additions had very little effect on the surface tension. AUTHORS.

4360. Capillary Ascent in Cylindrical Tubes. A. W. Porter. *Phil. Mag.* 26. *pp.* 519–520, *Oct.*, 1938.—It is shown by writing Poisson's and Rayleigh's capillary height formulæ in non-dimensional forms that the values given by the former formula are always too small, and those given by the latter are too great when $h_0/2r$ is less than about 2, the standard of reference being the tables of Bashforth and Adams. P. H. B.

4361. Structure of Thin Layers Formed on Single Crystals. R. Uyeda. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 656–666, *Aug.*, 1938. *In English.*—Thin layers of the oxidation product formed at high temperatures on a cleavage face of molybdenite were studied by the method of kathode-ray diffraction. The oxide was identified to be MoO_3 and the following two types of orientation were observed: The (111) plane of MoO_3 is parallel to the cleavage plane of molybdenite, and the direction normal to it is a fibre axis; The (010) plane of MoO_3 is parallel to the cleavage plane of molybdenite, and the (101) plane of the former is parallel to the $(10\bar{1}0)$ plane of the latter. A possible interpretation is given for the new pattern, which was reported previously by the author. AUTHOR.

4362. Electron Diffraction and Surface Structure. G. I. Finch. *Chem. Soc., J. pp.* 1137–1147, *Aug.*, 1938.—In this paper the results of all the important applications of electron diffraction to surface structure are reviewed and correlated, whilst some of the author's recent work is described, particular attention being paid to the problems of lubrication and running in. It is shown that in the case of an end-substituted normal paraffin, such as stearic acid, deposited on a plane surface, the long chains are not erect on the surface, as is the case with paraffin, but tilted over to some definite angle, in this case 53°, to the surface, but otherwise pointing in all possible directions. On firmly rubbing such a film in one direction the chains become inclined at about 5° to the surface and towards the direction of rubbing. No matter how the film is rubbed, the inclination of the chains is determined solely by the last stroke. It is also shown that during running-in with colloidal-graphited oil, minute graphite crystals are, as it were, rolled into the Beilby layer during its formation, and whilst this graphite is frequently not detected at once by electron diffraction, slight etching followed by gentle polishing suffices to afford the characteristic graphite pattern. A. G. Q.

4363. Structure of Electrolytically Polished Copper Surfaces. K. H. Moore. *Ann. d. Physik,* 33. 2. *pp.* 133–137, *Sept.,* 1938.—The surface of electrolytically polished Cu was examined by electron diffraction and shown to consist of Cu_2O. When the original Cu surface was polycrystalline the oxide film exhibited strong (110) orientation. With an electrolytically polished (110) face of a Cu single crystal, the oxide crystals arranged themselves with a cube edge parallel to the cube edge of the Cu crystal, whilst with the (100) Cu face various orientations were observed. The orientation most frequently observed was (111), the cube face diagonal of the oxide being approximately parallel to the cube edge of the underlying Cu crystal. A. G. Q.

4364. Structure of Oxide Surface Films. A. Winkel and R. Haul. *Zeits. f. Elektrochem.* 44. *pp.* 611–619; *Disc.,* 619, *Sept.,* 1938.—Aerosols of Fe prepared by thermal decomposition of $Fe(CO)_5$ in a current of N_2 were found to be subject to spontaneous oxidation on exposure to air. By X-rays it was shown that the size of the approximately cube-shaped active particles obtained at 220° C. was 90 Å whilst a short heating to 650° C. gave an inactive substance of grain size about 10^{-3} cm. It is pointed out that the properties of the aerosols could be due to lattice distortion or to the development of a very large free surface. The possibility of the existence of lattice distortion in the Fe produced by condensation from the metal vapour phase is thoroughly discussed, but it is concluded that in the present case the pyrophoric properties of the aerosol are to be attributed to the large effective surface area of the specimen. By electron diffraction it is shown that the oxide surface layers formed on the iron films consist of Fe_3O_4, and from the results of chemical analysis combined with the original X-ray estimates of the crystal size of the Fe it is concluded that the thickness of these oxide films is 9 Å, or approximately one unit cell of Fe_3O_4. In the *Discussion* **R. Brill** states that the authors' conclusions conflict with the work [see Abstract 2924 (1937)] in which he demonstrated the existence of lattice distortion in carbonyl Fe. A. G. Q.

4365. Construction of Filament Surfaces. R. P. Johnson. *Phys. Rev.* 54. *pp.* 459–467, *Sept.* 15, 1938.—An incandescent tungsten filament gradually loses its die marks and comes to display a surface whose structure depends on whether the lamp was evacuated or gas-filled, and on whether it was run on a.c. or d.c. Filaments heated *in vacuo* with a.c. remain smooth and nearly round. In neutral gas, with a.c., the filament tends to expose smooth concave (100) faces. The d.c. vacuum structure is steplike, is polarised with respect to the current, and seems to be due to a drift of W ions in the field along the filament. Surface migration of Th adsorbed on W, during d.c. heating, has been demonstrated in a simple electron-optical tube. Structure identical in form with the d.c. structure appears on a.c. filaments where a temperature gradient exists, and is attributable directly to surface diffusion in the temperature gradient. On d.c. gas filaments the d.c. structure and the gas structure are concurrent. No small-scale structure is found microscopically; probably the only substructure is atomic in scale. Preliminary study of Ta, Mo, Pt, Fe and Ni filaments *in vacuo* indicates that these metals also develop a roughened surface on d.c. heating, but remain smooth on a.c. AUTHOR.

4366. Physical Properties of Cyclo-Pentane, -Hexane and -Heptane and Derivatives. A. I. Vogel. *Chem. Soc., J. pp.* 1323–1338, *Sept.*, 1938.—The surface tensions and densities over a range of temperatures, and the refractive indices for the C, D, F, and G lines at 20° have been measured for pure *cyclo*pentane, methyl*cyclo*pentane, *cyclo*hexane, methyl*cyclo*hexane, *cyclo*heptane, and the related ketones, alcohols, and unsaturated hydrocarbons, together with a number of methylene compounds. The parachors, molecular refractivities, dispersions, and molecular refraction coefficients have been evaluated. Several forms of methyl*cyclo*hexane have been isolated; this provides evidence for the multiplanar structure of the simple *cyclo*hexane ring. AUTHOR.

4367. Temperature Variation of Electron Diffraction Patterns of Organic Films. K. Tanaka. *Kyoto Coll. Sci., Mem.* 21. *pp.* 85–88, *July*, 1938. *In English.*—Temperature variation of electron diffraction patterns reflected from films of grease, vaseline and paraffins was examined. It was observed that at some elevated temperatures the parallel arrangement of the molecules of the substances is gradually destroyed and with further rise of temperature it becomes haphazard. This transition temperature of the arrangement of the molecules differs with different substances and with different thickness of the films. AUTHOR.

4368. Nature of Foam. Part I. T. Sasaki. *Chem. Soc. Japan, Bull.* 13. *pp.* 517–526, *Aug.*, 1938. *In English.*—An apparatus for the measurement of the stability of foam is described and the stability is measured by the height of the foam produced by the air current of a constant velocity. The relation between the velocity of the air current v and the height H of the foam produced was examined and the equation $S \cdot v = H - a$ has been obtained, in which S is the stability of foam and a a constant. The value a is negligible compared with H under the conditions of the present experiments. The measurements of the stabilities were carried out for the aqueous solutions of alcohols and fatty acids, from which several conclusions have been obtained. AUTHOR.

4369. Properties of Thin Sheets of Noble Metals in Contact with Gases. M. Auwärter and K. Ruthardt. *Zeits. f. Elektrochem.* 44. *pp.* 579–585, *Sept.*, 1938.—The change point at definite temperature, previously observed in noble metals, when the electric resistance suddenly decreases, is confirmed for Pd and Pt. The " recrystallisation," however, can be induced, although more slowly, by saturating the films with H_2 at room-temperature, and continues on washing with N_2 or O_2. At higher temperatures the resistance suddenly undergoes a large increase, the critical temperatures being different for different gases. From measurements of the selective transmission of light it is deduced that Pd and Pt form compounds with H_2 and O_2. With thicker non-transparent films, it appears that below a limited depth the compounds of Pd with H_2 and N_2, and of Pt with H_2, N_2, and O_2, do not penetrate. The superficial coating is compared to a passifying layer. For Pt temperatures at which the resistance suddenly increases are: in contact with N_2 580° C., H_2 580° C., O_2 620° C.; in the later case the resistance drops from 250 Ω at 160° to 60 Ω at 300° C. owing to recrystallisation. The work is being extended to other metals. D. R. H.

***4370. Inexpensive Surface Tensiometer. H. N. Holmes.** *Science*, 88. *pp.* 223–224, *Sept.* 2, 1938.—Describes a simple tensiometer, based on that of Lloyd and Scarth, combining the ring method with the essential mechanism of the chainomatic balance. It can be built in a few hours at the cost of 4 shillings if a Ni ring is made, and 12 shillings if a Pt ring is purchased. Results within 0·1 dyne/cm. of the true values have been obtained with the apparatus by students. P. H. B.

4371. Spreading of Liquids in Filter Paper. Part II. K. Prosad and B. N. Ghosh. *Kolloid Zeits.* 84. *pp.* 275–283, *Sept.*, 1938.—Following up previous work [see Abstract 2985 (1937)] it was found that while the quantity of H_2SO_4 adsorbed per unit area is independent of concentration, the corresponding amount of HCl and H_3PO_4 increases with concentration. The phenomenon is a complicated one. The curves connecting the speed of spreading with area wetted fall (except for HCl and NaCl) into two or more sections, owing to the formation of hydrates. The part played by surface tension is discussed. P. H. B.

See also Abstract 4503.

TIME.

***4372. Production of Accurate One-Second Time Intervals. W. D. George.** *Bureau of Standards, J. of Research*, 21. *pp.* 367–372, *Sept.*, 1938.—This paper describes the technique wherewith a highly accurate frequency of 1 ∼ is obtained for broadcasting from the Bureau's radio station WWV. Multivibrators are used in obtaining lower frequencies from a radio-frequency standard. Observations are given concerning the nature of short-time instabilities occurring in controlled multivibrators. The measuring technique is described whereby the accuracy between successive time intervals or cycles is checked to better than one part in a million. It is pointed out that the arrangement can be used for supplying extremely short pulses accurately spaced in time. The frequency of 1 ∼ is added as a modulation on standard radio frequencies, which are broadcast. AUTHOR.

4373. Programme Selection in Time and Azimuth Determinations. T. Niethammer. *Bull. géodésique, No.* 56. *pp.* 273–289, *Oct.–Nov.–Dec.*, 1937. *In German.*—The author discusses the principles underlying the determination of clock corrections with a view to choosing the most suitable stars for observation. Certain recent developments in generalising the formulæ involved and in better meeting the requirements of the practical observer are critically examined. A. Hu.

VISCOSITY AND FRICTION.

4374. Viscosity Function. E. P. Irany. *Am. Chem. Soc., J.* 60. *pp.* 2106–2115, *Sept.*, 1938.—Due to insufficient knowledge of the structure of liquids it is impossible to formulate the basic and generally valid laws which relate liquid viscosity with variables of condition, such as volume (dilution), temperature and pressure. In the absence of real proof that such laws of broad validity exist, or that they are recognisable, a method of graphical analysis has been used to provide necessary evidence which has been summarised in three postulates, *viz.*, a function of viscosity exists, $\phi(\eta)$, or the "ϕ scale", which is generally additive, (1) in terms of volume, *i.e.*, of dilution in ideal mixtures, (2) in terms of temperature, *i.e.*, temperature and dilution have the same quantitative effects upon viscosity.

(3) Another function $\Pi(\eta)$, or the "Π scale," exists, which is generally additive in terms of pressure. When viscosities are plotted in these functional scales, all normal or "ideal" additivity is represented as a straight line, and deviations are very accurately recognisable and significant, *e.g.*, associative or dissociative tendencies are revealed which could not be detected by other means. Extrapolation into the critical region suggests important conclusions regarding state discontinuity. The Π scale shows the correct magnitude of the internal pressures of liquids. H. H. Ho.

4375. Structural Viscosity of Softening Selenium Glass. E. Jenckel. *Kolloid Zeits.* 84. *pp.* 266–268, *Sept.*, 1938.—Using the apparatus previously described [see Abstract 4786 (1937)], the author investigates the extension of rods of Se glass under different stresses at temperatures of 29·60, 31·35 and 34·73° C. It is found that the viscosity diminishes with increasing stress. The diminution can be represented well by means of a formula given by Philippoff, but the constant γ of this formula does not possess the significance of a modulus of elasticity.

L. A. W.

4376. Viscosity of Air. V. D. Majumdar and M. B. Vajifdar. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 171–178, *Sept.*, 1938.—Using a modified form of Wagstaff's apparatus for measuring the coefficient of viscosity of air by the method of interference fringes and using capillary tubes, the value of $\eta_{23^\circ C}$ has been found to be $(1834 \cdot 38 \pm 0 \cdot 35) \times 10^{-7}$ c.g.s. units. The value of the electronic charge, e, calculated with this value of η is $4 \cdot 816 \times 10^{-10}$ e.s. units. Both these values are in close agreement with those obtained recently by other workers using different methods.

Authors.

4377. Effect of Pressure on Viscosity of Boric Anhydride Glass. E. B. Dane, Jr., and F. Birch. *J. of Applied Physics*, 9. *pp.* 669–674, *Oct.*, 1938.—The effect of pressure on the viscosity of B_2O_3 glass has been determined by a high-pressure capillary flow method up to about 2000 kg./cm^2., at two temperatures, 516° and 359° C. The results are satisfactorily represented by the expression $\eta = \eta_0 e^{\alpha p}$, with $\alpha = 4.6 \cdot 10^{-4}$ cm^2./kg. at 516°, $\alpha = 15 \cdot 10^{-4}$ cm^2./kg. at 359° C. The ratio of the viscosity at 1000 kg./cm^2. to the viscosity at 1 atm. is therefore 1·58 at 516°, 4·48 at 359°. The results are briefly compared with those for organic liquids.

Authors.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4378. Transit Instruments. W. H. Rayner.** *Univ. of Illinois Eng. Exp. Sta., Circ. No.* 32. [17 *pp.*], *May* 17, 1938.—Two investigations are described one dealing with a comparison of transit verniers, the other with the relation between line of sight and axis of objective slide in transit telescopes. Various conclusions are drawn concerning the accuracy of such verniers whilst in the second case it is found that save in very exceptional cases the adjustment for this condition is unimportant. A. H.

***4379. Pretoria 74-in. Reflector.** *Engineer*, 166. *pp.* 298–301, *Sept.*, 16; 326–328, *Sept.* 23, *and pp.* 353–354, *Sept.* 30, 1938.—This telescope is similar in design to the Dunlap and Greenwich types having the "English" type lattice-work tube; the mirror's parabolic surface will have accuracy of about 10^{-6} in.; its support is such as to avoid distortion whatever the mirror position. The hollow steel polar and declination axes are described; the slow motions have two speeds. The constant-speed system is based on McMath's method at the Hulbert Observatory, Michigan, but instead of an oscillator, it will have a thermionically controlled tuning fork, made of elinvar without contacts, arranged in a constant temperature chamber. The housing consists of a rotating, cylindrical steel-work turret mounted on top of a concrete base. The turret has an outside diameter of 61 ft. The observing carriage is of novel design, and is built of steel angles and plates. Its basis is a vertical steel frame, 27 ft. by 10 ft. wide and is arranged to travel round the inside of the turret except past the 15 ft. observation gap. **A. S. D. M.**

COMETS AND METEORS.

See Abstracts 4416, 4417.

COSMOGONY.

4380. Curvature of Space and the Limited Dimensions of the Stars. L. Laboccetta. *Ricerca Scientifica*, 2. *pp*. 33–37, *July*, 1938.—It follows from the theory of relativity that the curvature of space, due to the presence of matter, limits the dimensions of a sphere of given density. In classical physics there corresponds to every density a time which is independent of the dimensions of the sphere. It is shown that for this time the mass and radius of a sphere, the normal sphere, remain finite if the velocity of light is chosen as limiting velocity. This time is the eigen-time of the sphere. The sphere can be characterised by a characteristic number which varies with the chosen system of units and is related to the eigen-time. For a sphere of the density of water the eigen-time corresponds to Maxwell's absolute unit of time and is proportional to Lippmann's natural hour. [See following Abstract.] **L. K.**

4381. Eddington's Relation between Radius of Electron and Radius of Universe. L. Laboccetta. *Ricerca Scientifica*, 2. *pp*. 164–166, *Aug*., 1938.—It was shown [see preceding Abstract] that the normal sphere is defined by a characteristic number which indicates the number of elementary particles forming the sphere. In this paper the author considers the case that the characteristic number is equal to the square of the cosmical constant ψ^2, and shows that Eddington's relation, that the cosmical constant is the ratio between the radii of the universe and of the electron, follows immediately. Furthermore, the author derives relations between the mean free path of a proton in the universe and the cosmical constant and the electronic radius, and between the gravitational constant, the mass of the universe and its radius. **L. K.**

4382. Origin of Planets. J. H. Jeans. *Science and Culture*, 4. *pp*. 73–75, *Aug*., 1938.—The author names the planetary theories formed from Descartes (1644) to Laplace (1796), discussing the latter's which considered that Saturn's rings were pre-natal; Roche (1852) is, however, conclusive that they are post-mortal. He describes his own tidal theory, propounded in 1916, and takes up the difficulties found by Jeffreys in this and all others which suppose that the planets originally formed part of the sun. Of such are Bickerton's, H. N. Russell's, Lyttleton's and Milne's. He concludes that though questions of rotation introduce certain difficulties into this tidal theory of his own, its many successes suggest that it is fundamentally on sound lines. A. S. D. M.

See also Abstract 4350.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

4383. Equilibrium of Fluid Masses. R. Wavre. *Comptes Rendus*, 207. *pp.* 460–462, *Sept.* 5, 1938.—The method of Volterra, by which it is proved that certain stratifications of the equilibrium figures of heterogeneous fluid masses cannot occur, is generalised by means of the theory of implicit functions. Dive's result that stratification in concentric ellipsoids is impossible for barotropic rotation is obtained in a simpler way, and an extension of the theorem to other forms of stratification is derived. A. Hu.

LATITUDE AND LONGITUDE.

4384. Variations of Latitude. L. Carnera. *Accad. Lincei, Atti*, 27. *pp.* 421–426, *May* 1, 1938.—The author tabulates the results from the observations of the coordinates of the pole. The observations have been made in five stations on the northern hemisphere in 1936 and 1937, and in two stations on the southern hemisphere. The author shows that the error in the determination of the variation of the latitude is of the same order as the periodical variations which shall be determined. It follows that astronomical instruments of a much higher degree of accuracy are wanted if the studies of local variations of a periodical character are to be continued. L. K.

NEBULÆ.

4385. Physical Processes in Gaseous Nebulæ. Part IV. D. H. Menzel, L. H. Aller and J. G. Baker. *Astrophys. J.* 88. *pp.* 313–318, *Oct.*, 1938.—The statistical equilibrium of nebulæ has been discussed in the past from two points of view. H. H. Plaskett employed a *mechanistic* argument, where the captures in a given level are subdivided according to the probability of transitions to lower levels and are followed through successive transitions down to the ground level. Carroll criticised Plaskett's treatment and developed equations on an *equilibrium* argument. The authors have shown that the two points of view, when properly applied, lead to the same result, and have derived the necessary equations, which will lead to a determination of electron temperature. [For Part III see Abstract 3137 (1938).] AUTHORS.

4386. Characteristics of Associated Galaxies. Part I. Density Restriction in the Metagalaxy. E. F. Carpenter. *Astrophys. J.* 88. *pp.* 344–355, *Oct.*, 1938.—The densities of distribution of galaxies in 42 metagalactic groups and clusters have been computed. The fundamental data were drawn chiefly from descriptions published at the Harvard and Mount Wilson Observatories. Distances of the latter set have been correlated with the red-shift, while distances of the former are entirely photometric, but results from both sources are consistent. Analyses of partly observed memberships of clusters are believed to furnish estimates of the total membership with sufficient accuracy for this investigation. The study shows that the smaller a cluster is, in dimensions and membership, the greater its density may be. The distribution of clusters in the density-volume diagram is bounded by the fairly well-defined envelope $\rho_{max} = 4400/\sqrt{V}$, and suggests that the conventionally recognised clusters of galaxies are not separate metagalactic entities but are merely the extremes of a nonuniform space distribution conditioned by the above-mentioned density restriction. The foregoing value of the constant of proportionality results from the adoption of $-14 \cdot 2$ as the average absolute magnitude of a galaxy. AUTHOR.

4387. Diffuse Nebulæ and Cosmic Absorption. V. A. Ambarzumian and S. G. Gordeladse. *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 37–52, 1938. *In English.*—The luminosity of a diffuse nebula is connected with some neighbouring star of large absolute brightness; the associated star may be either dynamically connected with the nebula or may be only temporarily in its neighbourhood. A statistical investigation of the distribution of nebulæ and stars of various types leads to rejection of the hypothesis of dynamical connection of nebula and bright star and tends to prove that the diffuse nebulæ accidentally meet their erstwhile associated stars in space; this leads to the conclusion that a large multitude of unilluminated diffuse nebulæ exists with random space distribution. Calculation shows that the magnitude of the absorption expected of such nebulæ agrees in order of magnitude with general absorption data; they are therefore presumably responsible for the absorption. On this basis no correlation is expected between the local surface brightness and selective absorption in the Milky Way. Emission nebulæ and "dark" nebulæ are both regarded as of the same fundamental type; diffuse nebulæ not illuminated by bright stars are "dark" nebulæ, diffuse nebulæ illuminated by B1 to M stars simply reflect their light and diffuse nebulæ illuminated by O and B0 stars give the emission spectrum. J. E. K.

PLANETS.

4388. Photoelectric Light-Curve of Eros. F. E. Roach and L. G. Stoddard. *Astrophys. J.* 88. *pp.* 305–312, *Oct.*, 1938.—Photoelectric observations of Eros made on Feb. 4–5, 1938, when the earth was in or near the asteroid's equatorial plane, are presented. A new analysis of the form and size of Eros, following Krug and Schrutka-Rechtenstamm, leads to a three-axis ellipsoid with axes of 35·0, 15·6, and 7·2 km. AUTHORS.

4389. Problem of Lunar Changes. W. H. Haas. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 347–352, *Sept.*, 1938.—The author tries to decide between incident light and physical change for lunar variation. He classifies these as (*a*) dark areas, (*b*) bright spots, (*c*) colours: for the times (1) 2 days from sunrise, (2) at sunrise, (3) at sunset, and for colours in addition, differences in darkness seen in shadows. He discusses these and the additional effects due to libration. He forms intensity curves, by plotting the intensity of a marking against the co-longitude. These curves can also be used to investigate the structure of the moon's surface if the lunar changes could be explained by incident light theory. For instance, photographs of Aristarchus in different wave-lengths indicate that its rock is sulphur-coated. The two theories could be tested in a lunar eclipse; on the incident light theory, an eclipse should have no effect in detail. A. S. D. M.

See also Abstracts 4338, 4382.

STARS.

4390. Spectrum of γ-Cassiopeiae. J. F. Heard. *David Dunlap Obs., Comm. No. 2. Roy Astron Soc. Canada, J.* 32. *pp.* 353–356, *Sept.*, 1938.—The author traces qualitatively the variations from 1937–1938 Aug., and measures the displacement of emission lines of H, ionised Fe, He, also ionised Ca, Mg, Si, Ni, Cr and Sc, all showing structure and variations similar to those of ionised Fe. No absorption lines were seen in 1937, but in 1938, ionised O and doubly ionised Si lines were seen, but weakening in July and Aug. A table is given of radial velocity measures. A. S. D. M.

4391. Lines of Ionised Barium in Stellar Spectra. C. G. Burwell. *Mt. Wilson Observat. Contrib. No.* 598. *Astrophys. J.* 88. *pp.* 278–284, *Oct.*, 1938.—Five A-type stars have been found in which the red triplet of Ba II is abnormally intense. All data agree that these stars are somewhat fainter than the average of the main sequence, although in later types Ba II is strong in giant stars. This behaviour of Ba II may be similar to that of Sr II in the F0 Sr " dwarfs." A brief comparison of the behaviour of Ca, Sr, and Ba is given. AUTHOR.

4392. Relationship Between Colour, Spectrum and Absolute Magnitude for G-Type Stars. J. S. Hall. *Astrophys. J.* 88. *pp.* 319–343, *Oct.*, 1938.—The colours and magnitudes of 170 bright HD G-type stars have been determined with a photoelectric photometer, sensitive to the infra-red, at the Sproul Observatory. A null method involving the use of two photo-cells was used to make 36% of the observations. It is briefly described. Accurate colour excesses were formed from a combination of these data, Becker's colours, and Hertzsprung's photographic magnitudes with accurate spectral types. These colour excesses are strongly related to the Victoria spectroscopic absolute magnitudes for stars of spectral class G2 to K0. The presence of red secondary components to several close visual binaries is strongly suggested by (1) a comparison of the blue-violet with the red-infra-red colours and (2) the unusually large differences (of the proper sign) between the Victoria and the colorimetric absolute magnitudes. The data suggest that two nearby stars not known to be binaries may have red companions. The colours of stars of spectral types F8 to G1 of the main sequence are found to show very little cosmic dispersion. This conclusion confirms that very recently formulated by W. W. Morgan [see Abstract 3452 (1937)]. AUTHOR.

4393. Spectrum and Radial Velocity of γ Persei. D. B. McLaughlin. *Astrophys. J.* 88. *pp.* 358–359, *Oct.*, 1938.—The K line of Ca II in this composite spectrum shows variations in velocity opposite to those of the solar-type spectrum. A period of about ten years is suggested. AUTHOR.

4394. Displacements of Absorption Lines in the Spectrum of P Cygni. E. K. Kharadse. *Abastumani Astrophys. Obs., Bull.* 1. *pp.* 39–46, 1937. *English Abstract.*—In previous investigations of the displacements of absorption lines in stellar spectra consideration appears never to have been given to the influence of neighbouring bright emission on the contour and displacement of a dark component. The existence of such an influence is confirmed in an investigation of the P Cygni spectrum and its amount is determined; when due allowance is made for this influence corrected values are obtained for the radial velocities of the absorption lines. Examination of the corrected data shows that Struve's correlation between radial velocities and ionisation potentials [see Abstract

638 (1935)] is undoubtedly real but that the correlation between radial velocities and intensities either does not exist or is extremely weak.

J. E. K.

4395. Compilation of Data for Stronger Lines in α Cygni Spectrum. A. B. Wyse. *Lick Observat., Bull. No.* 492. *pp.* 129–162, 1938.—The author has collected a part of the available material of Cygni (spectral Class A2p) for his own use, revising the laboratory identifications of the lines so as to make the list as homogeneous as possible. The similarity of α Cygni's spectrum to the absorption spectra of temporary stars when near their maxima makes it valuable to other investigators of Novae. He gives the sources of the identifications and describes the table which occupies pages 132–162. A. S. D. M.

4396. Relative Energy Distribution in the Continuous Spectrum of 36 Fundamental Stars. H. Kienle, H. Strassl and J. Wempe. *Zeits. f. Astrophysik*, 16, 4. *pp.* 201–275, 1938.—The spectra of 36 fundamental stars have been photometrically measured with two different objective-prism cameras and were brought into connection with each other. The photometric measurements which were carried out by means of wire gratings are chiefly discussed. The mean values of the directly observed connections are tabulated together with the relative energy distributions referred to the A0-stars. The differences of both instrumental systems and the deviations of the magnitudes from a linear function of $1/\lambda$ are shown in diagrams. L. K.

4397. Two Elementary Theorems on Polytropes. N. R. Sen. *Calcutta Math. Soc., Bull.* 30. *pp.* 11–16, *March*, 1938.—The maxima and minima of two invariants of homology associated with Emden's equation are discussed. G. C. McV.

4398. Galactic Structure in Taurus. Part I. Surface Distribution of Stars. S. W. McCuskey. *Astrophys. J.* 88. *pp.* 209–227, *Oct.*, 1938.—In order to study the structural features of the galaxy toward the anti-centre general star counts to photographic magnitude 15 have been made in an area of 600 square degrees in Taurus between $\alpha\ 2^h40^m$ and 5^h40^m and $\delta + 20°$ to $+ 35°$. The magnitude scale corresponds essentially to the International Photographic Scale, although there may be a systematic difference amounting to possibly 0·2 mag. for the brightest stars. The surface distribution of stars in arbitrarily selected regions of little or no obscuration is given and is compared with similar data by others. It is found that these areas exhibit an excess of 0·2 in log $N(m)$ over the data published by van Rhijn and by Sears and Joyner. An examination of the plates shows that this excess is undoubtedly due to the obscuring nebulosity overlying the Selected Areas on which previous stellar distributions in this region have been based. With the mean values of log $N(m)$ in the clear areas as a basis, the amount of absorption of photographic light at magnitude 15 has been determined for small subareas, the distribution being shown by a chart and by a contour map. The total absorption at the fifteenth magnitude in the condensations of the Taurus region reaches values as high as 3·5–3·7. mag. Over much of the region the obscuration amounts to 1·5–2·5 mag. The stellar space density in Taurus and a discussion of the dark nebulae will be presented in a succeeding paper. AUTHOR.

4399. Space Distribution of F-Type Stars. M. A. Vashakidse. *Abastumani Astrophys. Obs., Bull.* 1. *pp.* 87–96, 1937. *In English.*—The distribution of F-stars in the direction perpendicular to the galactic plane is computed. The material used comprises stars down to the 12th

magnitude in 14 Kapteyn areas of the southern hemisphere between galactic latitudes 31° and 73°. The absolute distribution of star density as derived is illustrated by a curve showing the number of F-stars per cubic parsec in dependence on Z ; at a distance of 600 parsecs the density decreases by a factor of 10. It is found that the density of stars in the direction perpendicular to the galactic centre is constant but in the direction opposite to the galactic centre the density is not uniform. [See following Abstract.]
J. E. K.

4400. Distribution of A, F and G Type Stars Perpendicular to the Galactic Plane and in the Direction to the Galactic Centre. M. A. Vashakidse. *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 109–127, 1938. *In English.*—A previous investigation on the distribution of F-type stars [see preceding Abstract] is extended to A, F and G stars ; the stars are those classed in Schwassmann's catalogue in Kapteyn areas 4, 5, 6, 8, 9, 11–16 and 19 of the northern hemisphere, nine of the areas in different galactic latitudes are used in deducing the distribution in the *z* direction (to the pole of the galaxy), the 3 areas, 8, 9, 10, are used in deducing the distribution in the *c*-direction (to the galactic centre). It is assumed that the equi-density layers are plane-parallel and parallel to the galactic plane. The calculated data connecting Nm, the number of stars per degree^2 brighter than magnitude *m*, with *m* are presented in tabular and graphical form. The luminosity functions are derived from material catalogued by Adams and others [see Abstract 1490 (1935)] in the case of A and F stars and by van Rhijn and Schwassmann [see Abstract 3358 (1935)] in the case of G stars. Curves and tables are given of the density D as a function of *z* and of *c*; the distribution agrees satisfactorily in the case of F and G stars with that derived by van Rhijn and Oort. J. E. K.

4401. Emission Nebulosities in Cygnus and Cepheus. O. Struve and C. T. Elvey. *Astrophys. J.* 88. *pp.* 364–368, *Oct.*, 1938.—Several extended regions in Cygnus and Cepheus are enveloped in diffuse nebulosities which show Hα and [O II] 3727 in emission. These nebulosities are usually not concentrated toward individual bright stars, and it is probable that they derive their light from the u.v. radiation of the integrated O and B stars in Milky Way star clouds. The faintest nebulosities observed require about 10 atoms of H in the third quantum level, in a column of 1 cm^2. cross-section. A rough computation shows that this interstellar H has a density corresponding to 0·01 atom per cm^3. AUTHORS.

4402. New Southern Double Stars. (Third List.) R. A. Rossiter. *Roy. Astron. Soc., Mem.* 66. 1. *pp.* 1–9, 1938.—[See also Abstract 524 (1936).]

4403. Quadruple System, 59 Serpentis. R. Tremblot. *Comptes Rendus*, 207. *pp.* 491–493, *Sept.* 19, 1938.—This star (of visual magnitudes, 5, 5, 7, 8) has a very slow orbital motion and is a double spectroscopic system with notable eccentricity and long period. 12 spectrograms have been obtained between July 15th and Aug. 8th, 1938, confirming the characteristics given in the Draper catalogue. The author concludes that it should be considered a quadruple star, behaving like 3 bodies in rapid motion. This is the fourth example of a star belonging to the Harvard composite type classification, recognised as a spectroscopic triple and showing lines of several constituents. A. S. D. M.

4404. Spectroscopic Triple Star 59d Serpentis. D. B. McLaughlin. *Astrophys. J.* 88. *pp.* 356–358, *Oct.*, 1938.—This star is composed of a close pair of nearly equal stars of class A having a period of about 2 days, and a distant G-type companion having a probable period of 15 years. The spectroscopic triple is the brighter component of a wide visual double. AUTHOR.

4405. Present Spectral Characteristics of Sixteen Old Novæ. M. L. Humason. *Mt. Wilson Observat. Contrib. No.* 596. *Astrophys. J.* 88. *pp.* 228–243, *Oct.*, 1938.—Spectra of 16 old novæ have been observed with a small-dispersion spectrograph. Observations have been made in the fields of two others in an effort to identify them by their spectra. Visual magnitudes of the observed objects range from 10·0 to 16·5. Charts of all the fields are given for the benefit of other observers. Most of the objects have a strong continuous spectrum extending well into the violet, in which neither absorption nor emission lines can be seen. They have therefore been classified as O Con, since the extension into the violet corresponds to that of O-type stars, or possibly of early B stars. When emission lines have been observed, the stars have been classified as O Em. In the search for Nova B Cassiopeiæ (1572), Baade observed an interesting faint blue star on a colour plate of the region. Its photographic magnitude is 17·0, its spectrum A0*n*. As the mean absolute magnitude for stars of this type is roughly + 1·0, the distance modulus, uncorrected for space absorption, is 16·0, thus indicating a distance of the order of 25,000 parsecs in a direction 125° from that of the galactic centre. It is not assumed that this star is the nova. Spectral types of four stars observed in the field of Nova Vulpeculæ (1670) indicate that this nova has not yet been rediscovered. One of these objects is the faint variable star found by W. H. Steavenson. With the exception of T Coronæ, all the novæ observed are blue and probably correspond in temperature with the O or early B stars. T Coronæ may also be blue if it is the companion of a red star. The density of Nova Persei (1901) in its present state is of the order of 220 ⊙. The corresponding value for Nova Aquilæ (1918) is 70 ⊙. For eleven novæ whose distances are not so reliably known, a mean density has been determined by using $M_{\max} = -7\cdot0$, the mean M of galactic novæ at maximum, from which their present mean M is obtained by adding the mean of their amplitudes. The resulting mean density of this group is 60 ⊙. AUTHOR.

4406. Absolute Photographic Magnitude of Supernovæ. W. Baade. *Mt. Wilson. Observat. Contrib. No.* 600. *Astrophys. J.* 88. *pp.* 285–304, *Oct.*, 1938.—A compilation of the photometric data for the 18 supernovæ known at the end of 1937 is given. Former estimates have been replaced by photometric magnitudes after a redetermination of the magnitudes of comparison stars on the international system. The mean absolute photographic magnitude of the supernovæ, derived from this material, is $\overline{M}_{\max} = -14\cdot3 \pm 0\cdot42$ (m.e.) with a dispersion $\sigma_{M\max} \approx 1\cdot1$ mag. This result, together with the spectroscopic evidence, fully confirms the view that two classes of novæ, common novæ and supernovæ, exist. Attention is drawn to the curious fact that 72% of the known supernovæ appeared in late-type spirals. B Cassiopeiæ and the Crab nebula, which may have been galactic supernovæ, are discussed. AUTHOR.

4407. Mass Ejected during Nova Outburst. S. G. Gordeladse. *Abastumani Astrophys. Obs., Bull.* 1. *pp.* 55–85, 1937. *English Abstract.*—Three independent methods are used for estimating the mass ejected during the outburst of a typical nova, 8 of the better-known novæ being studied for the purpose. The results confirm that the assumption of an ejection from the surface of the star of a finite amount of matter accounts satisfactorily for the main maximum and the subsequent sharp fall in brightness. The mass ejected depends on the absolute magnitude at maximum. The relatively slow decrease of brightness suggests that an instantaneous ejection is accompanied by a continuous outflow from the surface into space. This is confirmed by the similarity of the spectra of late novæ with Wolf-Rayet spectra. Secondary eruptions account for the subsequent small maxima. The ejected mass is least for stars which are faintest before outburst. The geometrical similarity at some stages between novæ and planetary nebulæ is discussed, and it is suggested that only supernovæ retain a permanent envelope and become planetary nebulæ. A. Hu.

4408. Final-Phase Temperatures of Novæ. S. G. Gordeladse. *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 69–97, 1938. *English Abstract.*—Zanstra's method for determining the temperatures of Wolf-Rayet stars is considered with a view to applying it to novæ in their final stages of outburst. The model examined consists of a star surrounded by a gaseous envelope of small radius containing atoms in 4 quantum states. The total amount of Balmer quanta formed in the envelope depends not only on the u.v. radiation of the central star in the Lyman continuum but also on that in the Balmer continuum. The importance of the latter effect depends at a given temperature on the ionisation potential: it is large at low temperatures (12,000° C.) for He and He^+ and for H. For different initial spectral lines, different temperatures are obtained corresponding to their excitation potentials. The reliability of the high temperatures obtained is therefore questionable. Thence the theory that the density increases during the outburst is not necessary to explain the fact that the final brightness differs little from the initial. A. Hu.

4409. Energy Liberated during Nova Outburst. S. G. Gordeladse. *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 99–107, 1938. *English Abstract.*—The energy liberated during an outburst must suffice to overcome the gravitational attraction between the star and the ejected envelope, to endow the envelope with kinetic energy, and to provide the radiation during the outburst. These 3 quantities are computed for a typical nova. The condition that the energies concerned should be of the same order of magnitude as one another is better satisfied by assuming a continuous outflow than by an instantaneous ejection. The energy of the outburst is of the order of 10^{44} to 10^{46} erg. A. Hu.

See also Abstracts 4387, 4413, 4414, 4463, 4473.

SUN.

4410. Solar Prominences. Part I. M. Waldmeier. *Zeits. f. Astrophysik,* 16. 4. *pp.* 276–290, 1938.—A statistic is given of the solar prominences which have been observed in the years 1936 and 1937. The size, mean life and number of prominences have been investigated. The greatest number of eruptions occurs in a distance of 20°–30° from the central meridian of the sun; there is a strong decrease on the limb. With very few exceptions the prominences are observed in groups of sunspots, and they show a tendency to appear in the same places. The number as well as the intensity of the prominences depends on the type and the phase of development of the corresponding sunspots. The author shows that the number of coincidences of prominences in widely distant groups of spots is not greater than can be expected. L. K.

4411. Prominence Studies. R. R. McMath and E. Pettit. *Mt. Wilson Observat. Contrib. No.* 597. *Astrophys. J.* 88. *pp.* 244–277, *Oct.*, 1938.—Data for seven new eruptive prominences confirm the laws of motion previously stated. The end velocity is now shown to revert occasionally to a whole multiple of the second preceding velocity, which explains some apparent exceptions to the second law. One prominence reached the unparalleled height of 1,550,000 km. and another the record velocity of 728 km./sec. The former was near the north pole of the sun. A calculation of the Milne effect shows that we cannot assume that light-pressure balances gravity at the sun's surface. Velocities of more than 100 km./sec. are developed in a few minutes from an initial 10 km./sec. velocity. Ca tends to separate widely from H. The motions in the fountain-like loops of class III*b* prominences are down both branches from the ends of the bright tops of the arches. Practically all obey the first law, and about 20% the second law of prominence motion ; 7 cases show no change in velocity. Small faint lumps of chromospheric matter are sometimes ejected from a spot area, at considerable angles to the vertical. These ejections seem to move in nearly straight trajectories and do not return. Examination of the dissolution of an active prominence projected on the disc shows that centres of attraction are not visible as surface markings. With one exception, prominence streamers have always been seen to enter centres of attraction from one side only. 50% of all the streamers from class I prominences measured followed both laws of prominence motion. When a centre of attraction becomes very active, long streamers not connected with the active prominence enter the centre of attraction from great heights. These seem to come from space in the middle or outer corona. They obey both laws of motion of eruptive prominences. AUTHORS.

4412. Dimensions of Solar Granules. P. C. Keenan. *Astrophys. J.* 88. *pp.* 360–364, *Oct.*, 1938.—From observations in visual light the average diameter of the larger granules which are ordinarily observed is estimated at $1''\cdot 4$, or 1100 km. Their centres are spaced about 1500 km. apart, so that they occupy about 35% of the surface area of the sun. Their total number at any moment is roughly 2,600,000. AUTHOR.

4413. Stellar Groups Moving with the Sun. L. Gialanella. *Accad. Lincei, Atti,* 27. *pp.* 403–409, *April* 24, 1938.—The author continues his study of the statistics of the two stellar groups moving parallel to the sun [see Abstract 1536 (1938)]. He has calculated the cartesian coordinates of the 122 stars and their absolute magnitudes. The results are tabulated and shown in a diagram. The stars are arranged in an open cluster. There is no indication of the twofold plane stratification of Horn. 35·8% of the stars belong to the spectral type A, 11·4% to B, 16·2% each to F and G while K is represented by 15·4% and M by 4·0%. It is furthermore shown how the stars of the first and second group are distributed among the spectral types, and a statistic of the mean spectral velocities and the absolute magnitudes is given. L. K.

4414. Occurrence of Metallic Absorption in Celestial Spectra. L. Biermann. *Zeits. f. Astrophysik,* 16. 4. *pp.* 291–296, 1938.—The work of Minnaert and v. d. Briel [see Abstract 2350 (1938)] is reviewed from the theoretical standpoint. The author surveys the possibility of theoretically calculating the continuous absorption coefficients needed for deciding whether or not continuous metallic absorption should be expected in the spectra of the sun or stars. The necessary accuracy demands the use of quantum-mechanical methods, as yet unperfected, for calculating oscillator strengths which are at present undetermined. On the experimental side, an unobjectionable answer to the question can only be given when photometric measurements of the continuous spectrum have been made over wave-length regions as yet unexplored. A. Hu.

4415. Solar Magnetism. V. C. A. Ferraro. *Observatory*, 61. *pp.* 241–247, *Sept.*, 1938.—The author first reviews the discovery of sunspot and general magnetic fields in 1908 and 1913, and gives their characteristics; second, the theories of Chapman and Gunn in 1928, and of Cowling showing that the effects are spurious on which these theories were based; third, the non-uniform rotation of the sun and its magnetic field. He states that if a general solar magnetic field exists, it is unlikely that it is radially limited to the extent suggested by the 1913 observations. He gives the chief features of the sun's magnetic field; discusses Larmor's suggestion that this field is due to electric currents flowing in horizontal circuits around the spot, and Cowling's criticism of this; also Cowling's suggestion of its production by horizontal distortion of the general field of the sun by the motion of sunspot gases. He supports Bjerknes' qualitative theory of sunspots. A. S. D. M.

4416. Astrophysics at North Pole. B. G. Fessenkoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 8. *pp.* 605–606, 1938. *In French.*—Suggestions for observation during the polar night are made (*a*) of the behaviour of atmospheric O_3 under photochemical reactions to u.v. solar light; (*b*) of night sky luminosity, since its continuous spectrum varies photographically by 300% whilst its visual light is more constant; (*c*) of its line 5577 which varies regularly during the night, reaching a maximum shortly before midnight, and photometric observations should be made both by photography and by eye; (*d*) of the zodiacal light by the same visual method (a radioactive wedge photometer). This is always visible at the north pole in a clear sky as a large luminous band spread out at the horizon, and having two wings. As this is composed of interstellar meteoric material its density cannot be constant; (*e*) of counts to be made both telescopically and by eye of the number of meteor trails. A. S. D. M.

ZODIACAL LIGHT AND GEGENSCHEIN.

4417. Origin of Zodiacal Light. B. G. Fessenkoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 677–679, 1938. *In French.*—The author investigates the origin and nature of the cosmic particles which are accumulated in the plane of the ecliptic near the sun and which cause the zodiacal light. The variation of particle density Δ with radius vector r follows the formula $\Delta \sim r^{-k}$, where k is approximately 0 for galactic meteors penetrating the solar system with hyperbolic velocities, $k \leq 1$ for elliptic meteors arising from parabolic comets captured by Jupiter, $k \geq 1$ for elliptic meteors emitted by a planet, $k = 2$ approximately for electronic particles continuously expelled from the sun. The observed variation of density in zodiacal matter corresponds most closely to the third case. It is deduced that meteorites originate inside the solar system. A. Hu.

See also Abstract 4416.

GEOPHYSICS.

GEODESY.

4418. Equatorial and Meridional Moments of Inertia of the Earth. N. Mihal. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 689–692, 1938. *In German.*—The paper is wholly mathematical. R. S. R.

See also Abstract 4336.

HYDROSPHERE, PHYSICS OF THE.

4419. Periodic Oscillations of Annual Mean Sea-Level and Their Relations with Climate. J. Legrand. *Bull. géodésique, No.* 56. *pp.* 247–272, *Oct.–Nov.–Dec.*, 1937.—The nature of the problem is first considered and thereafter the method adopted in the investigation outlined. The periodic oscillations here considered are deduced from observations at different points in the oceans over the earth's surface. On a large series of charts are set out the results arrived at. These deal with observations in some cases extending for periods of 50 years and over. The author considers that from the investigation it is possible to state that there exists (1) a multiplicity of waves of the same period causing the maxima or minima of the annual mean levels, (2) a specialisation of certain rhythms, if not certain periods, in regions far distant the one from the other, (3) a doubt as to the existence of long periods. The direction in which investigation may be extended is indicated, while it is also pointed out that definite results for predication in changes of climate demand systematic research, a work for which, in the author's opinion, the Corps of the colonial meteorologists is particularly qualified. A. E. M. G.

4420. Effect of a Travelling Atmospheric Disturbance upon the Sea Surface. T. Takegami. *Kyoto Coll. Sci., Mem.* 31. *pp.* 55–74, *May*, 1938. *In English.*—The effect of a travelling cyclone on the surface of the sea, taking into account the presence of a coast, is investigated. The theory agrees reasonably with observations of abnormally high water caused by cyclones. W. A. R.

4421. Tides in Oceans Bounded by Meridians. Part III. A. T. Doodson. *Roy. Soc., Phil. Trans.* 237*A. No.* 779. *pp.* 311–373, *June* 10, 1938.—Continuing previous work [see Abstract 4092 (1936)] a solution of the semidiurnal tidal problem has been reached for an ocean bounded by a complete meridian and is illustrated for twenty values of the depth of the ocean. The genesis and development of amphidromic systems, as the depth changes, can be traced. The possible systems of cotidal lines are of great variety. W. A. R.

4422. Ra and Rn Content of Pacific Ocean Water, Life, and Sediments. Robley D. Evans, A. F. Kip and E. G. Moberg. *Am. J. Sci.* 36. *pp.* 241–259, *Oct.*, 1938.—The authors have measured the Ra content of sea water from the Pacific and Atlantic coasts of the United States. In all cases the results are several orders of magnitude lower than those obtained by previous workers. Instrumental reasons are given for regarding the lower results (*ca.* 10^{-16} gm./cm^3. Ra) as correct. A large increase in Ra concentration with depth in the ocean has been found at several stations. This suggests that Ra is being continuously precipitated out of the ocean. The bottom mud in quiet deep water shows a high Ra content, mainly due to high radioactivity af the finest particles in the sediment. These fine particles are possibly organic, and as further evidence that biochemical precipitation processes play an important rôle in ocean chemistry, the Ra content of a few marine plants and animals is shown to be of the order of 100 times that of the water in which they live. The oceans must be more widely sampled and many more analyses must be made before the problems of oceanic Ra chemistry may be completely solved, but the general character of the results is becoming clearer.

AUTHORS.

See also Abstract 4423.

LAND, PHYSICS OF THE.

4423. Internal Structure of the Globe; Origin of Continents and Oceans. A. Dauvillier. *Comptes Rendus*, 207. *pp.* 452–454, *Aug.* 29, 1938.—The earth is regarded as consisting of a central ferro-nickel (11% Ni) nucleus *d* 8·0, surrounded by sima of the composition of stony meteorites, *d* 3·0–3·4. The radioactivity of this is only 1/100 of that of the portion outside, and so only sufficient to maintain the temperature uniformly at 1200°. It is enclosed in an isothermal "furnace" of sial maintained at this temperature, *d* 2·8–3·0, which is regarded as consisting of granite floating on pasty basalt magma. On cooling, the granite crust solidified first and subsequently broke up to form a polygonal network, the meshes being more or less circular, similar to the "seas" of the moon, each depression being bordered by a fosse and ridge, and forming the originals of the five oceans. The seas originated through reduction of the metallic oxides of the sial by the H_2 of the then atmosphere to form metal and H_2O; the absence of H_2O on the moon being due to all H_2 having escaped. C. A. S.

4424. Stability of Magnetic Thermoremanence in Baked Clay and Stones. J. G. Koenigsberger. *Gerlands Beitr. z. Geophys.* 53. 4. *pp.* 345–351, 1938.—Objects of baked clay, bricks, vessels, and igneous rocks have a residual magnetism, J_{RC}, which is acquired while cooling from the Curie points of their contained magnetites in the earth's field. The relation between J_{RC} and the volume susceptibility for fields < 2 Oe, the maximum remanence per cm^3., and the coercive force all vary with the material and the intensity and duration of baking. The fundamental differences between bricks of different material are brought out by heating. Besides the decrease of residual magnetism produced by heating, there is a spontaneous decrease at ordinary temperatures which is all the more rapid the lower the Curie point and the coercive force; for high values of these, J_{RC} is permanent. In order to obtain reliable conclusions, a study of the magnetisation-temperature curves of the material is advisable.

G. E. A.

4425. Natural Residual Magnetism of Eruptive Rocks. Part II. J. G. Koenigsberger. *Terr. Mag.* 43. *pp.* 299–320, *Sept.*, 1938.—Details of the methods of measurement, and the actual results thereof are given for samples of magnetite (both artificial and natural), and of some 50 effusive and intrusive rocks. Some connection appears to exist, in some cases at least, between the results, the age of the rock and the earth's magnetic field in past epochs. [For Part I see Abstract 3168 (1938).] C. A. S.

4426. Magnetic Properties of Rocks. Part I. Y. Katô. *Tohoku Univ., Sci. Reports*, 27. *pp.* 91–100, *July*, 1938. *In English.*—The magnetic susceptibility of pumice erupted in 1929 from Mt. Komagatake

(Hokkaido) was investigated. No change was caused by pulverisation. The variation caused by change in temperature showed the magnetism to be due, practically entirely, to the magnetite (3·69%) in the pumice. C. A. S.

METEOROLOGY.

4427. Upper Air Temperature from Dissociation Theory. K. Senda. *J. Shanghai Sci. Inst. Sect. I.* 1. *pp.* 163–174, *June*, 1938. *In German.*—The temperature of the upper air has been determined by mechanical statistical methods from the dissociation theory in the same way as Saha has used the ionisation theory for the determination of stellar temperatures. For O_2 to dissociate almost completely into the atomic state and N_2 to be maintained for the most part in the molecular state one must make an assumption of a molecular density of 10^6–10^8 in unit volume in order that the earth's atmosphere at the F-layer, 220 km., shall show a temperature between 1400° and 2000° K. This temperature is somewhat higher than that indicated by other lines but agrees rather well with the general arrangement. R. S. R.

***4428. Katabatic Winds and Prevention of Frost Damage. C. E. Cornford.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 553–585; *Disc.*, 585–587, *Oct.*, 1938.—A new instrument for recording air movements of low velocity and air temperature fluctuations, and a portable anti-radiation screen, suitable for a grass minimum thermometer, are described. Experiments are described showing that certain conditions must be fulfilled in making a just comparison between the air temperature in an orchard-heated plantation and in an unheated plantation. Observations of air currents on hillsides on radiation nights are presented, which show that two winds exist, the "hilltop" wind and the katabatic wind. The effect of each on the other in certain localities is described. It is shown that the hilltop wind is able, on the higher part of a slope facing it, to push uphill the air in the first 10 ft. or so above the ground, and at a lower level to neutralise the force of the katabatic wind, producing a calm belt on the slope. Experiments designed to demonstrate the magnitude of air temperature differences caused by differences in the vegetative cover of the soil alone, by differences in altitude alone, and by a third unknown factor, are described. Evidence is presented showing that when a katabatic wind moves down a slope its temperature does not necessarily decrease. It is indicated how the new information may be applied to the problem of preventing frost damage to crops. AUTHOR.

***4429. Equal-Area Transformation of Indicator Diagram and New Aerological Chart. W. Werenskiold.** *Geofysiske Publ.* 12. 6. [10 *pp.*], 1938. *In English.*—On an indicator diagram the work done in a cyclic process can be found directly from the area traced. In some cases the ordinary $p\ v$ diagram is sufficient, but in aerological work other diagrams may be more convenient. So the condition for equal area transformation of the plane v, p upon the plane x, y is stated and examined. Certain examples are then considered. Particular relations between v, p and x, y are now stated and the corresponding chart drawn. The various purposes for which the chart can be used, and the methods of obtaining the results from observed data are indicated with the aid of diagrams. A reproduction of the chart is given. A. E. M. G.

4430. Diurnal Variation of Atmospheric Condensation-Nuclei. N. E. Bradbury and H. J. Meuron. *Terr. Mag.* 43. *pp.* 231–240, *Sept.*, 1938.—Records of the diurnal variation of the density of atmospheric condensation-nuclei have been obtained over a period of four months. The apparatus employed consists of a Wilson cloud-chamber with an expansion ratio of 1·15. At regular intervals the air in the chamber is replaced by a fresh sample, saturated with water-vapour, and subjected to an expansion. A beam of light passing through the chamber is diminished in intensity by the resulting fog, and the degree of extinction may be related to the nuclei-density. The diurnal variation in nuclei-density shows a definite maximum in the forenoon and in the evening with a pronounced minimum prior to sunrise and a midday minimum of lesser extent. Such a variation might be expected in the normal daily convective cycle. The average hourly values of nuclei-density have been compared with the hourly averages of the local component of the diurnal variation of the earth's electric field. The results indicate that in a large measure, if not entirely, the variations in the local component of the earth's potential-gradient arise out of variations in the nuclei-density. AUTHORS.

4431. Presence of Sodium in the Atmosphere. R. Bernard. *Zeits. f. Physik*, 110. 5–6. *pp*. 291–302, 1938.—A critical examination of recorded data shows that the yellow line of the night sky, which has an atmospheric origin, has a wave-length of 5892·6 Å. An interferometric investigation at twilight shows that this radiation is produced by Na atoms, probably existing in a thin layer of air about 60 km. high. The line has not been observed in the auroral spectrum. [See Abstracts 3623 and 3625 (1938).] W. R. A.

4432. Coefficients of Atmospheric Haziness. P. Lejay. *Comptes Rendus*, 207. *pp*. 439–442, *Aug*. 29, 1938.—The energy arriving at the earth's surface from the sun is examined by a spectrograph [see Abstract 5275 (1937)]. An expression connecting this energy with that arriving at the upper boundary of the atmosphere and the coefficients of absorption for particles of different sizes is given. Methods of determining these coefficients are outlined. A table gives the values of the coefficients determined between Nov., 1936 and March, 1937. Now Ångström has suggested the existence of a preponderating size of diffusing particles in the air. From the observations it appears that these particles exist and that their coefficient of absorption has the form suggested. The author considers that many geophysicists, himself included, still have difficulty in admitting this curious fact. A. E. M. G,

4433. Path of Ray of Light Tangent to Surface of Earth. J. Sweer. *J.O.S.A.* 28. *pp*. 327–329, *Sept.*, 1938.—The general equations of the path of a ray of light passing through the terrestrial atmosphere are outlined. The path of the ray tangent to the earth's surface is calculated for the U.S. standard atmosphere. From this is prepared a table of horizon dip, horizon distance, and refraction for altitudes from sea level to 100,000 feet. AUTHOR.

4434. Processes and Conditions in the Auroral Region. L. Vegard. *Geofysiske Publ*. 12. 5. [23 *pp*.], 1938. *In German*.—The main problems of spectrum analysis in auroral investigation are examined. New measurements are given relating to the OI, OII and NII lines and the OI triplets and the strengthening of the red OI triplets with increasing heights. Typical intensity distributions and the stimulation of the auroral spectrum are described. The intensity of the first positive group is found to decrease quickly with height. The relation of the two height effects of the A and B types of reddish aurora are described. It is found that red auroræ of the B type occur most frequently at sunspot minima, and thus with maximum penetration of electric solar rays, as required by the author's theory. Further theory relating to the highest atmospheric layers and the facts on which this is based are described, particularly with regard to the temperature and density and the E- and F-layers, and confirmation of it is obtained. Finally remarks are made on the density distribution at great heights. R. S. R.

4435. Auroral Phenomena and the Structure of the Ionosphere. L. Vegard. *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 229–281, 1938.—The investigations and problems of auroral phenomena fall into two main groups. In the first of these we are concerned with the external forms, the geographical distribution and the time variations of the auroræ, also with possible relations between them and other cosmic phenomena such as magnetic disturbances, earth currents and variations of solar activity. The second group includes questions related to the physical phenomena in the highest layers of the atmosphere and in this connection the aurorae themselves are not the only object of investigation, but furnish a powerful means of studying the upper layers of the atmosphere. The present paper gives a comprehensive review of the most important recent publications on the subject. In this the auroral spectrum and its variations play an important part, together with spectral analysis. Tests of the accuracy of the results regarding the upper layers of the atmosphere furnished by auroral investigations, are supplied by allied investigations such as those of the light of the night sky and of radio echoes, both of which have extended the knowledge of the electrical condition of the highest atmospheric layers. A. W.

See also Abstracts **4416, 4420, 4441.**

SEISMOLOGY.

4436. Travel-Times of Seismic Waves P and S. A. W. Lee. *Meteorolog. Office, Geophys. Mem.* 9. 76. [16 *pp.*], 1938.—The travel-times of P and S waves are examined, using the data published in the International Seismological Summary of 1930 and 1931 for 146 well-recorded earthquakes; the shocks are all of normal focal depth. The observations of P are in good agreement with the travel-time table published by Jeffreys and Bullen in 1935. For S the observations are generally later than the tabulated times at distances less than 28°, and earlier than the tabulated times beyond 60°. For distances beyond 28° the observations support the amended table given by Jeffreys in 1936. The departures of the S observations from the tables at distances less than 28° are discussed. It is found that there may have been some confusion in the identifications of S up to about 12°, but at the greater distances the discrepancy cannot be explained in that way. Re-examination of the Kew records for a number of earthquakes at distances from 12° to 28° shows that, at least for some shocks, the arrival of S is preceded by a small movement, but this is so inconspicuous that it cannot be mistaken for the large onset generally accepted as S. A new table of travel-times for S has been constructed from the I.S.S. observations of the 146 earthquakes. The interpretation of the observations from the Kew seismograms is improved by the use of this new table. AUTHOR.

4437. Focal Points of SKS. B. Gutenberg. *Seismological Soc. of America, Bull.* 28. *pp.* 197–200, *July,* 1938.—The travel-time curve of the first section of SKS depends much on the velocity in the outer part of the core. It begins on the travel-time curve of ScS at an epicentral distance somewhere between 65° and 90°, depending on the velocity of longitudinal waves just below the surface of the core. The extreme values correspond to velocities there of approximately 8·0 and 7·4 km./sec., respectively. If the distance where SKS begins is relatively large, its first section extends to decreasing distances and is convex towards the axis of distance, and SKS must have an odd number of cusps with focal points (at least one) where it reverses in direction and changes from convex to concave or vice versa. If SKS begins at a relatively short distance, its first segment extends to increasing distances and is concave towards the axis of distance ; in this case the number of cusps is even (possibly zero). In an intermediate case, SKS begins with a focal point. In any case, the first segment of the travel-time curve of SKS is below the travel-time curve of ScS. Similar conclusions are correct for SKKS. A preliminary study of the observations seem to indicate a focal point of SKS at a distance between 70° and 80°. More detailed investigations which are under way may be used to draw conclusions respecting the velocity of longitudinal waves in the outer part of the core. AUTHOR.

4438. Rayleigh Waves. H. Bateman. *Nat. Acad. Sci., Proc.* **24.** *pp.* **315–320,** *Aug.*, **1938.**—With the interaction of air and ground, air waves are generated during an earthquake. The problem investigated mathematically is a type of free vibration of the air and ground, having characteristics of the Rayleigh wave, except that the velocity of propagation is less than that of sound in air instead of slightly less than the velocity of the shear wave in the ground. The effects of variation of wind-velocity and air temperature with height are also considered. The effects and speed of ground roll are discussed and its variation with the depth of the focus. In a further paper (*ibid. pp.* 321–325) various relations of Coulomb's function bearing on Rayleigh waves are treated mathematically. R. S. R.

4439. Earthquake Sounds. C. Davison. *Seismological Soc. of America, Bull.* **28.** *pp.* 147–161, *July*, **1938.**—The reports of sounds in a large number of earthquakes, mainly British, are analysed. The sounds are usually low-pitched, and almost on the limit of audibility—below it in the case of some observers. They appear frequently to be heard before, more rarely after, the shock, and their maximum to coincide with that of the shock ; the area of audibility is usually rather less than that in which the shock is felt, rarely the reverse. C. A. S.

4440. Volcanoes, Geysers and Hot Springs. A. L. Day. *Frank. Inst., J.* **226.** *pp.* **341–352,** *Sept.*, **1938.**—The composition and physical character of the magma and the participation of steam and other gases in the action are considered. Differences in the action of volcanoes, hot springs, roaring fumaroles, steam jets and geysers in various localities are discussed. These lead to the conclusion that volcanoes and hot springs have a common source of energy, the magma approaching the surface and cooling there, and that the most active agents in volcanic outbreaks and hot springs are the more volatile components of the magma. These seek to escape as they approach the surface and subsequent behaviour is determined by their composition, by the total energy available, the temperature, and the local conditions encountered. R. S. R.

See also Abstract 4443.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4441. Electrical Field and Radiation of the Atmosphere. E. Medi. *Ricerca Scientifica*, **2.** *pp.* 139–147, *Aug.*, **1938.**—An account is given of the first results obtained from a comparative study of the behaviour of the electrical field of the earth and of the radiation of the atmosphere. From a minute analysis considerable analogies are found to occur and raise the question whether there exists a common cause of these phenomena. For the measurement of the electric field the author has used a zero method which he has previously described [see Abstract 1091 (1935)]. The observations can be made accurately and rapidly, as *e.g.*, the record of the change of the electric field owing to the passage overhead of a cloud charged with electricity. Simultaneously with observations of electric field and radiation the temperatures and relative humidity of the air near the apparatus were observed. A suggested explanation of the facts observed is that they are due to the action of solar rays on aqueous vapour with the consequent phenomena of evaporation and condensation. The author concludes that the comparative study of the electrical field and radiation of the earth consists chiefly in the minute analysis of variations of small period. These are important for determining the state of the atmosphere, and for meteorological forecasting. J. J. S.

4442. Electrical Charge Distribution in Thunderclouds. A. K. Dutta. *Science and Culture*, 4. *pp.* 67–72, *Aug.*, 1938.—After reference to the normal condition of the earth and the atmosphere, the author discusses the polarity of thunderclouds and methods of investigating the same. A brief *resumé* is given of Simpson's theory regarding the origin of electricity in thunderstorms, which led to negative polarity. Careful experiment indicates, however, positive polarity. The methods of investigation used in determining polarity are indicated. An explanation is offered for the presence of the negative charge on the earth's surface. Some recent experiments by Simpson on the distribution of the electric charges in a thundercloud are described. It is considered that further observation is required before the problem of electric charge distribution can be fully settled. A. E. M. G.

4443. Changes in Earth's Magnetic Field Accompanying Earthquakes or Volcanic Eruptions. Y. Katô. *Tôhoku Univ., Sci. Reports*, 27. *pp.* 1–90, *July*, 1938. *In English.*—Numerous examples of changes in the magnetic elements at or near the epicentre of an earthquake or the scene of a volcanic eruption that have coincided with these phenomena are given. This is followed in some cases by a calculation of the equivalent change in a suitably magnetised sphere suitably situated which would produce the same effect. The changes are attributed to movements in magmatic material of differing susceptibility, and more probably to changes in susceptibility due to change in temperature. Whether the changes precede the earthquake or eruption sufficient to give useful warning is discussed. C. A. S.

4444. Asymmetrical Characteristics of the Earth's Magnetic Disturbance-Field. E. H. Vestine. *Terr. Mag.* 43. *pp.* 261–282, *Sept.*, 1938.—Asymmetries in the earth's magnetic disturbance-field are considered in relation to the asymmetries in the earth's main field, using data of 32 stations. The auroral-zone curve of terrestrial magnetism, in north polar regions, is elongated in a direction roughly parallel to the elongation of isoclinic curves. It agrees roughly with the the curve of maximum auroral frequency, as given by Fritz, except in regions where his auroral data were scanty. The curve appears to undergo regionally a small diurnal oscillation. The amplitude of the disturbance diurnal variation (S_D) is approximately symmetrical with respect to the geographical equator in low latitudes, is zonal-symmetrical with respect to the auroral zone, and has a zero vertical component near the north pole given by the eccentric dipole. No change in amplitude with longitude has been detected, and it is concluded that induced earth-currents in the oceans contribute little to S_D. The local time-phase of the mainly sinusoidal variation S_D shows a range of about 4 hr. with longitude. But if in defining time the geographic north pole be replaced by the north pole given by the eccentric dipole, then at the auroral zone there is no significant variation in time-phase with longitude. This suggests that the auroral zone has a controlling and initiating influence over the world-wide electric currents responsible for S_D. Average asymmetries in the geographical distribution of magnetic disturbance and aurora are compared. The average force-vectors for the daily means of disturbance are perpendicular to the average directions of homogeneous auroral arcs, to a high degree of approximation, in polar regions. The S_D electric current-system of magnetic storms proposed by Chapman shows good general agreement with the extensive data here considered. Certain changes are suggested whereby the fit with observation may be improved. AUTHOR.

See also Abstracts 4425, 4430, 4477.

RADIOACTIVITY.

4445. Theoretical Method in Radioactivity. M. Ferber. *J. de Physique et le Radium*, 9. *pp.* 337–344, *Aug.*, 1938.—A new method of studying statistical series of the exponential type such as occur in radioactive decay, is outlined. Contrary to the usual procedure, this method uses fractions containing an equal number of intervals. A bidimensional distribution in linear relationship with the distribution $\beta e^{-\beta x}$ is the basis of the method. The distribution is characterised by a unique term, for which an expression is given. The theory is applied to an automatic recording of the α-particles from Po. The agreement between theory and experiment is satisfactory. Certain peculiarities in the curves of total frequency and in the observed instants have suggested a possible interpretation which is discussed. G. O. B.

4446. Radon Condensation Method of Determining Geologic Age. N. B. Keevil. *Am. J. Sci.* 36. *pp.* 304–309, *Oct.*, 1938.—A modified method of determining the He age is described which overcomes the two criticisms of the two methods previously described. The danger of contamination or removal of Rn during the chemical procedure is eliminated by condensing the Rn directly from the fluxed rock. Another advantage is that all of the determinations can be made on the same specimen, thus lowering the errors due to inhomogeneity. Some preliminary results of Rn determinations and the comparison of the results by three methods on a specimen of the Quincy granite are given. AUTHOR.

4447. Disintegration Constant of Th and Branching Ratio of Th C. A. F. Kovarik and N. I. Adams, Jr. *Phys. Rev.* 54. *pp.* 413–421, *Sept.* 15, 1938.—In age determinations of minerals in which Th predominates, some inconsistencies have appeared when the value used for the disintegration constant of Th is that adopted by the International Radium-Standard Commission (1930). This value differs from the

original Geiger-Rutherford value by 30%. The present research was undertaken to determine the disintegration constant of Th by the method of counting α-particles. Easily weighed sources were used. The material was obtained from a thorite from the same lot that was used by Geiger and Rutherford. The thorite contained only a small amount of U and correction for the ionium present was made. Various checks on the counting are given. The half-value period of Th was found to be $1\cdot39(10)^{10}$ years and the branching ratio, Th C′ to Th (C + C′), is 0·663. A method of impounding the thoron, yet permitting α-particles to escape, is described.
AUTHORS.

4448. Decay Constant of P^{32}. N. B. Cacciapuoti. *N. Cimento,* 15. *pp.* 213–219, *April,* 1938.—Using an ionisation chamber and a Perucca electrometer, the half-value of P^{32} is found to be 14·295 days within an error of two parts in 1000.
F. C. C.

4449. Neutron Disintegration of Be and B by Bombardment with α-Particles from Po. G. Bernardini. *N. Cimento,* 15. *pp.* 220–225, *April,* 1938.—It has been shown [see Abstract 2305 (1937) that for several light nuclei resonance levels occur for α-particles at about 4 eMV. Using similar apparatus to that previously employed it is found that there is an intermediate level for C^{12} at 2·7 eMV above the ground state.
F. C. C.

***4450. Beryllium Isotope of Mass 8. O. Laaff.** *Ann. d. Physik,* 32. 8. *pp.* 743–760, *Aug.,* 1938.—A design of valve amplifier is described suitable for the quantitative measurement of the ionisation effect in an ionisation chamber due to the entry of individual fast particles derived from artificial nuclear disintegration processes; the amplifier is carefully protected from disturbances of electrical, magnetic and mechanical nature. With this amplifier and an ionisation chamber it is demonstrated that the Be^8 nucleus disintegrates spontaneously into two α-particles which under suitable experimental conditions can be received simultaneously in the ionisation chamber and produce a correspondingly increased impulse. The Be^8 is derived from Be^{11} by bombardment of the latter with 185 ekV protons, the process being $Be^{11}(p, \alpha)Be^8$. It is deduced from the dependence of the number of 2 α-particle impulses on the aperture of the ionisation chamber that the disintegration energy must be less than 200 ekV.
J. E. K.

4451. Radioactive Mn Isotopes. J. J. Livingood and G. T. Seaborg. *Phys. Rev.* 54. *pp.* 391–397, *Sept.* 15, 1938.—Five radioactive decay periods of Mn have been obtained by bombarding Co, Fe, Mn, Cr and V with neutrons, deuterons and α-particles. Arguments are given for the assignment to various isotopes, as follows:

Reaction	Half-life	Reaction	Half-life
$Cr^{50}(d,n)Mn^{51}$	46 ± 2 min. (+)	$Mn^{55}(n,\gamma)Mn^{56}$	2·59 ± 0·02 hours (−)
$Fe^{54}(d,\alpha)Mn^{52}$	21 ± 2 min. (+) 6·5 ± 1 days (+)	$Mn^{55}(d, p)Mn^{56}$	
$Fe^{56}(d,\alpha)Mn^{54}$	310 ± 20 days (*k* electron capture)	$C^{53}(\alpha,p)Mn^{56}$	
$C^{53}(d,n)Mn^{54}$		$Fe^{58}(d,\alpha)Mn^{56}$	
$V^{51}(\alpha,n)Mn^{54}$		$Fe^{56}(n,p)Mn^{56}$	
		$Co^{59}(n,\alpha)Mn^{56}$	

No evidence has been found for radioactive Mn^{53}. Chemical identification has been made in all instances, except for the case of the bombardment of V with α-particles. The 46-min. period emits positrons with a range

0·9 gm./cm². Al and annihilation radiation absorbed to half-value by 5·0 gm./cm². Pb. The positrons from the 6·5-day activity have a range 0·2 gm./cm². Al. The 310-day activity consists of a soft radiation, whose absorption coefficient is consistent with that of the Cr *Kα* X-ray line, and also a γ-ray reduced to half-value by 8·4 gm./cm². Pb. The range of the electrons from the 2·6 hour Mn^{56} has been measured as 1·3 ± 0·1 gm./cm². Al, while the γ-ray is brought to half-value by 11·4 gm./cm². Pb.
AUTHORS.

4452. γ-Rays from F Due to Proton Bombardment. E. J. Bernet, R. G. Herb and D. B. Parkinson. *Phys. Rev.* 54. *pp.* 398–408, *Sept.* 15, 1938.—A detailed study has been made of the resonance excitation of γ-rays from F when bombarded with high speed protons in the energy range 0·18 to 2·2 eMV. Because of improvements in the h.v. generator and in the preparation of uniform thin F films, the resonance peaks obtained are much narrower than in the previous work at this laboratory, and many new resonances have been discovered. For the seven resonance peaks which are best defined, estimates are given as to voltage position and half-width.
AUTHORS.

4453. Transmutation of Ti by ThC′ α-Particles. W. L. Davidson, Jr. and E. Pollard. *Phys. Rev.* 54. *pp.* 408–410, *Sept.* 15, 1938.—Protons have been observed from the bombardment of Ti by ThC′ α-particles. They are probably due to the reaction $Ti^{48} + He^{4} \rightarrow V^{51} + H^{1}$. Three groups of protons are found corresponding to nuclear energy change [*Q*] values of + 1·10,0·00 and − 3·63 eMV. The separation of the last two groups is abnormally great. Combined with Dempster's value for the mass of Ti^{48}, the results lead to a mass of 50·9598 for V^{51}.
AUTHORS.

4454. Transmutation of Sc by ThC′ α-Particles. E. Pollard. *Phys. Rev.* 54. *pp.* 411–412, *Sept.* 15, 1938.—The emission of protons from Sc under bombardment by ThC′ α-particles has been observed according to the reaction $Sc^{45} + He^{4} \rightarrow Ti^{48} + H^{1}$. Three groups of protons are found corresponding to nuclear energy changes −0·3, −1·4 and −2·6 eMV. With Dempster's value for the mass of Ti^{48} the mass of Sc^{45} is deduced to be 44·9599.
AUTHOR.

4455. Transmutation of F by Protons and Deuterons. W. E. Burcham and C. L. Smith. *Roy. Soc., Proc.* 168*A*. *pp.* 176–190, *Oct.* 25, 1938.—The transmutations of F under bombardment with artificially accelerated protons and deuterons have been systematically investigated. The energy of the group of α-particles which is emitted during bombardment of F with protons has been accurately determined and leads to a value 19·0043 for the mass of ^{19}F, in good agreement with the mass spectroscopic value. From the value of the energy release in this process and from the absence of α-particle groups of smaller energy it is concluded that the γ-ray emission from F under proton bombardment arises from successive transitions of excited ^{20}Ne nuclei. Five groups of α-particles were found to be emitted during bombardment of F with deuterons and the energies of these groups have been determined. From the energy values of these groups it is concluded that excitation levels at 0·83, 2·95, 3·77 and 4·99 × 10^{6} eV above the ground state exist in ^{17}O nuclei. The emission of a group of protons which is believed to be associated with the formation of ^{20}F has been observed. From the energy of these protons the value 20·0087 has been deduced for the mass of radioactive ^{20}F. An energy release of 9·2 × 10^{6} eV is therefore to be expected in the radioactive decay process $^{20}F \rightarrow {}^{20}Ne + e^-$ and the disagreement between this value and the observed end point energy of the β-rays ($5 \cdot 2 \times 10^6$ eV) has been partially reconciled by the observation that a radioactive emission of γ-radiation accompanies the β-emission and decays with the same period. AUTHORS.

4456. Capture of Orbital Electrons by Nuclei. L. W. Alvarez. *Phys. Rev.* 54. *pp.* 486–497, *Oct.* 1, 1938.—The simple theory of electron capture is outlined and three general methods for its detection are suggested. The first experimental evidence for the process (in activated Ti) is described. A rigorous experimental proof of the hypothesis is given for the case of Ga^{67}. A summary of several isotopes whose properties are best explained on this hypothesis is appended. The properties of Ga^{67} are described in considerable detail, and include the first evidence for internal conversion in artificially radioactive atoms. AUTHOR.

4457. Variational Theory of the α-Particle. H. Margenau and W. A. Tyrrell, Jr. *Phys. Rev.* 54. *pp.* 422–435, *Sept.* 15, 1938.—The energy of the normal state of the α-particle is calculated with the use of an elaborate variational method, in which a fixed set of nuclear constants in the general symmetric Hamiltonian has been adopted. The result agrees well with an earlier, independent calculation, and allows the convergence limit to be determined with considerable precision. Comparison with previous work on H^3 indicates that the binding energies of both H^3 and He^4 can be very nearly accounted for with the use of a single set of constants satisfying the conditions imposed by the triplet state of H^2; but the value of g (ratio of Heisenberg to Majorana forces) required is lower than usually supposed, and will give somewhat too low an energy for the singlet state of H^2. The same methods are employed to calculate the excited singlet and triplet states of the α-particle, and yield the results which have already been stated. No excited state is stable. A virtual excited state is shown to exist near the energy of dissociation into four particles. AUTHORS.

4458. β-Spectrum of RaE near the Upper Limit and Mass of the Neutrino. A. Alichanian, A. Alichanov and B. Dželepov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 5. *pp.* 375–376, 1938. *In English.*—The spectrum of β-particles from RaE departs from that given by the Uhlenbeck-Konopinsky formula in the upper limits. There is a change in the curve at about 1120 kV, after which the number of electrons decreases nearly linearly. The whole curve fits the Uhlenbeck-Konopinsky theory for $\mu = 0 \cdot 3\ m_0$. [See Abstract 1577 (1938) and following Abstract.] H. G. C.

4459. β-Spectrum of ThC near the Limit and Mass of the Neutrino. A. Alichanian and S. Nikitin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 5. *pp.* 377–378, 1938. *In English.*—The spectrum of ThC shows a break at 2130 kV after which it falls off nearly linearly. The whole curve is satisfied by $\mu = 0 \cdot 8\ m_0$ in the Konopinsky-Uhlenbeck formula. This and the result for RaE show μ is not a constant for all elements. [See preceding Abstract.] H. G. C.

4460. Angles between the Components of a Pair. A. Alichanian, B. Dželepov and P. Spivak. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 5. *pp.* 379–380, 1938. *In English.*—The pairs from Po, electrolytically deposited on a foil of Al-Be alloy were registered in two Geiger-Müller counters at six different angles. A comparison with the theory of Uhlenbeck and Rose suggests the results agree more closely with those for quadrupole than dipole transition, but this is not conclusive. A pair created by γ-rays (Po and Be) in Pb were similarly investigated, but the comparison with theory presents difficulties. H. G. C.

***4461. Pulse Chopper of the Geiger-Müller Counter. M. Kozodaev and G. Latyschev.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 21–23, *and pp.* 25–28, 1938. *In English.*—By reducing the resistance in Geiger counter circuits to 10^6 ohms it is found much easier to obtain a horizontal portion in the usual count-voltage curve. The arrangement suffers from the disadvantage that the counts must be limited to 200–300 per min. if the registration of counts is to be reliable. It is shown how to allow theoretically for lost counts. M. Kozodaev (*ibid.* pp. 25–28) gives further details and properties of the circuit. F. C. C.

See also Abstracts **4271, 4273, 4274, 4422, 4482, 4673, 4678, 4685, 4718, 4719.**

RADIATION.

ABSORPTION.

4462. Optical Properties of Liquid Suspensions. L. Amy. *Comptes Rendus,* 207. *pp.* 329–331, *Aug.* 1, 1938.—It has been shown [see Abstract 3518 (1937)] that for a diffusing surface $\alpha/\delta = (1-R)^2/2R$, where α is the coefficient of absorption, δ of diffusion and R of refraction. It follows that the colour of a suspension is approximately independent of its dilution. This has been checked in many cases. More precisely, the interparticle volume increases slightly more rapidly than the total volume for a constant volume of particles on dilution. Hence α and δ are not proportional. This is checked experimentally. H. G. C.

4463. Theory of Absorption in Ionised Gas. Part I. Opacity in Stellar Material. Part II. Optical Properties of Liquid Metals. B. Majumdar. *Indian Journ. Phys.* 12. *pp.* 233–248, *Aug.,* 1938.—A quantum theory of absorption of electromagnetic radiation by ionised gas is worked out, in which the electrons take up energy from the electric field of the incident radiation and transform it by collisions with ions to random motion of electrons and ions. The theory is applied to calculate the opacity coefficients in stellar interiors and the results are compared with those obtained by Eddington from Kramers' process of absorption for a free-free transition. The optical properties of liquid metals are studied from this general theory and found to agree fairly well with the observations. AUTHOR.

4464. Colour in Relation to Chemical Constitution. I. N. D. Dass and S. Dutt. *Indian Acad. Sci., Proc.* 8*A. pp.* 145–159, *Sept.,* 1938.—Diphenyl-thio-violuric acid has an orange colour in the solid state or in solution in organic solvents, but on treatment with alkalies or organic bases, intense blue and green coloured salts are formed, the transition of colour being sufficiently strong and sharp for the substance to act as an excellent indicator. The change of colour from orange to blue or green has been shown from theoretical considerations to be due to a fundamental change in the constitution of the molecule from an oximino-ketonic to a nitroso-enolic structure. The above change in the molecular structure results in the production of a true nitroso-group, which from the point of view of a theory of colour on the basis of molecular strain advanced by Dutt, has been shown to be the most highly strained amongst the chromophoric groups, and consequently produces the greatest intensity of colour. The loading effect of the two phenyl groups as well as that of the S atom from the point of view of colour production is discussed, and it is shown that the effect is quite in accordance with the theory. From the study of the absorption spectra of the salts of diphenyl-thio-violuric acid it has been found that their intensity of colour is roughly proportional to the strength of the basic character of the base entering into salt formation. Further study of the absorption spectra of the salts of a series of newly synthesised higher homologues and analogues of diphenyl-thio-violuric acid indicates that the effect of additional load on the molecule of the substance is to produce still further intensification of colour as expected from theoretical considerations, the greatest effect being produced by substituents in *meta*-positions closely followed by those in the *para*. AUTHORS.

See also Abstract 4503.

COLORIMETRY.

4465. Ideal Colour System. Part II. Reconsideration of the Helmholtz Line Element. R. H. Sinden. *J.O.S.A.* 28. *pp.* 339–347, *Sept.*, 1938.—The first paper of this series [see Abstract 2537 (1937)] proposed a re-examination of the Helmholtz colorimetric line element, and described a new mechanico-graphical device that has been employed to assist in selecting the coordinate system for which this expression gives best agreement with modern colorimetric data. The coordinate system thus found is fundamentally different from the one determined by Helmholtz himself, and brings about a greatly improved agreement with experimental measurements. In the present paper the new coordinate system is defined, and numerical results afforded by the Helmholtzian function within this frame of reference are compared with observed data and also with the consequences of another theoretical construction. Conclusions are reached concerning the tenability of the assumptions upon which Helmholtz' derivation rests. AUTHOR.

***4466. Simplified and Compact Tricolour Mixing Device. C. N. Warfield.** *Am. Phys. Teacher*, 6. *pp.* 211–213, *Aug.*, 1938.—This lecture-demonstration device utilises colour filters and small wedge-type prisms in front of the focusing lens of an ordinary projection lantern to produce three over-lapping coloured circles on a screen. The relationship between the additive and subtractive primary colours is demonstrated by substituting an opaque circle mounted on clear glass for a circular aperture in the lantern slide holder. AUTHOR.

4467. Photographic Colorimetry of Dark Surfaces. E. v. Angerer and J. O. Brand. *Zeits. f. techn. Physik*, 19. 9. *pp.* 254–259, 1938.—A photographic method is described for determining the reflection factor of surfaces as a function of wave-length. The specimen surface and a comparison white surface are illuminated with a source emitting a line spectrum. By a special device the reflected rays from each surface are caused to illuminate only one half the width of the entrance slit of the spectrograph. Thus two slightly displaced line spectra are obtained on the plate. A Hirsch-Schön screen is used to obtain a known variation of intensity along the length of the lines due to the light from the comparison surface. Thus by noting where the adjacent lines on the photographic plate give equal blackening the reflection factor can be determined.

W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4468. Electric and Magnetic Birefringence of Liquids. A. Goldet. *Ann. de Physique,* 10. *pp.* 103–172, *July–Aug.,* 1938.—The thermal variation of the birefringence in electric and magnetic fields of benzene and 20 of its derivatives is examined up to 200° C. Liquid mixtures have been examined near the critical point of miscibility. Certain liquefied gases have been examined at low temperatures. Refractive indices have been examined in a new type of apparatus at high and low temperatures. Contrary to the results of some previous authors, the present measurements show analogy between the various phenomena.

H. G. C.

4469. Magnetic Rotatory Power of HF. R. de Mallemann and F. Suhner. *Comptes Rendus,* 207. *pp.* 494–495, *Sept.* 19, 1938.—Direct measurements on an aqueous solution of HF show that the molecular magnetic rotation of HF is very small, as predicted from theoretical considerations. The magnetic rotatory power of the F′ ion has the same order of magnitude as that of the H^+ ion.

W. R. A.

EMISSION.

4470. Analogy between Photon and Electron and Derivation of Quantum Equation. H. T. Flint. *Phys. Soc., Proc.* 50. *pp.* 899–909, *Nov.* 1, 1938.—On the view that the theory of the electron is exactly analogous to the theory of the photon, a quantum law is derived which is shown to require the existence of the first-order equation of the quantum theory. The notation required for this purpose is developed, and it is shown to have certain advantages. The limiting character of the fundamental lengths h/m_0c and e^2/m_0c^2 follows naturally, and the notation suggests that the latter should be regarded as a limit to the application of present physical theory.

AUTHOR.

4471. Čerenkov Radiation. G. B. Collins and V. G. Reiling. *Phys. Rev.* 54. *pp.* 499–503, *Oct.* 1, 1938.—Electrons of 2×10^6 V energy from an electrostatic generator were used to investigate the properties of the asymmetric radiation discovered by Cerenkov [see Abstract 2080 (1937)]. This radiation is produced when electrons traverse a material medium with a velocity greater than the velocity of light in that medium. It was found for several solids and liquids that the direction of the emission of the radiation is accurately expressed by the relation, $\cos\theta = 1/\beta n$, and that the intensity maximum is quite sharp. The nature of the radiation from all solids and liquids investigated was found to be continuous and identical in appearance. The radiation apparently extends with increasing intensity from the infra-red to the u.v. absorption limit of the medium in which it is produced. Rough quantitative measurements of its intensity indicate that one $1{\cdot}9 \times 10^6$ V electron in being brought to rest in water produces 40 quanta in a wave-length range 4000 Å to 6700 Å. These results are in good agreement with the classical explanation of the phenomenon given by Frank and Tamm [see Abstract 2082 (1937)].

AUTHORS.

4472. Theory of Showers. D. Iwanenko and A. Sokolow. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 681–682, 1938. *In English.*—By using the saddle point method to evaluate an integral, formulæ are obtained for the number of particles and the number of photons in the theory of showers. G. O. B.

4473. Nature of Primary Cosmic Radiation. T. H. Johnson. *Phys. Rev.* 54. *pp.* 385–387, *Sept.* 1, 1938.—The author supposes the existence of some unspecified process within the atmospheres of stars in which either electrons or positive ions are given an original impulse. As these pass outwards through the stellar atmosphere secondary positive and negative electron pairs and an equilibrium intensity of photons are generated. It is shown how, with the aid of the assumption of a galactic magnetic field, the radiation reaching the earth is reduced to a mixture of positive and negative electrons in equal numbers, constituting the soft component of the cosmic radiation, and a group of heavy positive particles whose penetrating secondaries produce most of the intensity at sea-level and below and account for the east-west asymmetry. The mechanism suggested avoids the building up of enormous potential differences between relatively close points in inter-stellar space. D. H. F.

4474. Theory of Cosmic-Ray Phenomena. H. Euler and W. Heisenberg. *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 1–69, 1938.—The main phenomena of cosmic radiation are reviewed theoretically from the point of view of the adequacy of quantum mechanics to cover them, even to the highest energies. The paper divides into five parts: (*a*) general review of the properties of single particles, (*b*) theory of the light particles (electrons and positrons), (*c*) theory of the heavy particles (heavy electrons, protons and neutrons), (*d*) energy spectrum of the radiation and its absorption, (*e*) discussion of the secondary effects (*e.g.*, showers). A Bibliography is appended. D. H. F.

4475. Absorption of Cosmic Rays in Water to Depth of 440 m. J. Clay, A. v. Gemert and P. H. Clay. *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 694–705, 1938.—Measurements of cosmic-ray intensity were made with an ionisation chamber, and with coincidence-counting assemblies for which the selected cone of rays had various values, with and without Pb screens between the counters. Definite, though sometimes small, differences were found between the intensity-depth curves under the different conditions. It is concluded that at a depth of 200 m. the proportion of soft rays begins to increase, the proportion being greatest between 280 and 400 m. Comparison with results obtained in a mine shows that the decrease in intensity is proportional to the density of the absorbing medium. Below 50 m. the results can be represented by $I = I_0/h^2$ and hence an expression for the energy distribution of the rays is calculated. D. H. F.

4476. Zenith-Angle Intensity Distribution of Cosmic Rays. J. Clay, J. T. Wiersma and K. H. J. Jonker. *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 706–708, 1938.—The zenith-angle distribution was measured with counters in the E.–W. and N.–S. directions, at a magnetic latitude of 50°, and in both cases the intensity is found to be approximately proportional to $\cos^2 a$ (a = zenith angle). With 30 cm. Pb between the counters higher values relative to the vertical intensity are found, but it is calculated that if the Pb had been placed as a horizontal layer over the counters the $\cos^2 a$ distribution would have been obtained. It is concluded that the decrease of the number of particles is inversely proportional to the square of the thickness of material traversed; the coefficient of decrease of oblique rays is smaller than that of vertical rays. D. H. F.

4477. Cosmic-Ray Effects Associated with Magnetic Storms. S. E. Forbush. *Terr. Mag.* **43.** *pp.* **203–218**, *Sept.*, **1938.**—Evidence indicates that the storm-time field of some magnetic storms causes world-wide changes of several per cent in cosmic-ray intensity. That other magnetic storms of equal intensity at the earth's surface occur with no appreciable cosmic-ray effects definitely indicates that the entire current-system for the storm-time field of both types of storms cannot be located at the same distance above the earth. In particular, the possibility that the current-systems responsible for the two types of storms both lie within the earth's atmosphere appears remote. Assuming the current-system for the storm-time field of both types of storms to consist of a ring concentric with the earth in the geomagnetic equatorial plane, magnetic data are analysed to determine whether the radius of the assumed ring is, as would be expected, greater for magnetic storms, which affect cosmic-ray intensity. Although the analysis is not conclusive on this point, the results satisfy a necessary condition for the existence of such a ring-current. The occurrence of aurora in temperate latitudes during most of the magnetic storms which affected cosmic-ray intensity is interpreted, after Störmer, to indicate the existence of such ring-currents. The percentage-changes in cosmic-ray intensity during magnetic storms is within the observational uncertainty the same at geomagnetic latitudes 50°·1 N. and 0°·6 S. The significant correlation between changes in daily means of cosmic-ray intensity, for two stations separated 50° in latitude, probably results from the same mechanism responsible for the magnetic-storm effect. AUTHOR.

4478. Bursts in Cosmic Radiation in the Equatorial Zone. S. A. Korff. *Terr. Mag.* **43.** *pp.* **227–230**, *Sept.*, **1938.**—Bursts in cosmic radiation observed in Peru and in northern latitudes are compared. It is found that the bursts have the same distribution in energy both at high altitudes in the equatorial zone and at sea-level in northern latitudes. The number of bursts is found to vary approximately as the third power of the number of ions in the burst. The number of bursts increases with altitude approximately as the square of the total ionisation measured in the same instrument. Bursts are found to produce about one part in 1000 of the ionisation observed in the instrument. AUTHOR.

4479. Multiplicative Production of Hoffmann Bursts. H. Euler. *Zeits. f. Physik*, **110.** **7–8.** *pp.* **450–472**, **1938.**—Two classes of Hoffmann bursts are distinguished; this paper deals with those resulting from multiplicative cascade processes. It is shown that the quantitative characteristics of the bursts, especially in relation to the variation with height above sea-level, are consistent with the assumption that they are due to electrons, falling into two distinct classes: (i) secondary to the penetrating component, comprising most of the electrons at sea-level, varying little with height and responsible for most of the bursts below about 1000 particles; (ii) secondary to the extra-terrestrial electron component of the primary radiation, decreasing rapidly with increasing depth in the atmosphere, comparable in intensity at sea-level with class (i) only at the highest energies, and responsible for the bursts of more than about 1000 particles. An energy distribution for the electrons in this group is calculated. In an Appendix an expression for the fluctuations of the sizes of the bursts is derived. D. H. F.

4480. Hard Cosmic-Ray Showers. K. Schmeiser. *Zeits. f. Physik*, 110. 7–8. *pp.* 443–449, 1938.—It is found that the absorption-curves of the hard showers reported previously [see Abstract 2423 (1938)] are independent of the nature of the material in which they originate, and that their absorption by different materials is mass-proportional. It is confirmed that the intensity of the showers is approximately proportional to the atomic number of the shower-producing material. Experiments were performed to show that the so-called *Zusatzstrahlung* which, according to Zeiller [see Abstract 4226 (1935)] is liable to vitiate absorption measurements, actually consists of soft showers secondary to the hard showers. D. H. F.

4481. Absorption of Shower-Producing Component of Cosmic Radiation in Iron and Lead. J. Crudup. *Phys. Rev.* 54. *pp.* 483–486, *Oct.* 1, 1938.—Measurements of the absorption coefficient of the shower-producing component of primary cosmic radiation give 0·35 cm^{-1}. in lead and 0·076 cm^{-1}. in iron. The atomic absorption coefficients corresponding to these values are nearly in direct proportion to the squares of the atomic numbers of the absorbing materials. The value 0·35 cm^{-1}. for lead agrees rather well with that found by Woodward. A slight minimum was found in the curve of the absorption for lead at a point between 8 and 10 cm., confirming similar findings by Rossi and others. No minimum was found in the absorption curve for iron up to a thickness of 20 cm. For the rays received within a given solid angle, the ratio of the shower rate to the vertical coincidence rate falls from 5·1% with no shield to 2·6% with 15 cm. of lead, and to 3·0% with 20 cm. of iron. AUTHOR.

4482. Report on the Work of the Bartol Research Foundation, 1937-1938. W. F. G. Swann. *Frank. Inst., J.* 226. *pp.* 441–503, *Oct.*, 1938.

See also Abstracts **4458, 4459, 4515, 4561, 4674.**

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4483. Nitrogen Afterglows. D. B. McNeill and K. F. Harvey. *Phil. Mag.* 26. *pp.* 502–506, *Oct.*, 1938.—In a previous paper [see Abstract 1605 (1938)] some phenomena connected with active nitrogen and nitrogen afterglows were described. In this an account was given of the action of impurities in the discharge and a hypothesis was advanced to explain the production of the intercombination (Vegard-Kaplan) bands. These bands have not yet been produced with the intensity required for their rotational structure to be analysed. In the present paper, some attempts to develop strong sources of the bands are described. These failed in their original purpose, but other observations were made, which are described together with experiments on the diffusion of the Lewis-Rayleigh form of the afterglow and its behaviour in a magnetic field. AUTHORS.

INTERFERENCE, DIFFRACTION AND SCATTERING.

4484. Diffraction of Converging Light Waves. I. Fränz-Gotthold and M. v. Laue. *Ann. d. Physik*, 33. 3. *pp.* 249–258, *Oct.*, 1938.—The diffraction arrangement described by Lau [see Abstract 3569 (1937)], in which the diffraction pattern in the focal plane of a lens is made sharper by the introduction of an opaque screen into the edge of the converging light beam, is now treated mathematically. C. B. A.

See also Abstracts **4562, 4610, 4611, 4661.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4485. Photochemistry. *J. Phys. Chem.* 42. *pp.* 699–854, *June*, 1938.—The third report of the Committee on Photochemistry, National Research Council, consisting of an Introduction by **H. S. Taylor** (*pp.* 699–700) and the following 11 papers.

" Experimental Technique in Photochemistry," by **F. Daniels** (*pp.* 701–711).—Records advances in technique dealing with light sources, production of monochromatic light, measurement of radiation, reaction cells, chemical analysis, high and low temperatures, and absorption spectra.

" Table of Quantum Yields in Experimental Photochemistry," by **F. Daniels** (*pp.* 713–732).

" Nature of the Primary Process in Photochemical Reactions," by **G. K. Rollefson** (*pp.* 733–737).—Summarises the more recent aspects of the primary absorption process.

" Comparisons between Photochemical Processes in Gases and Solutions," by **R. G. Dickinson** (*pp.* 739–748).

" Mechanism of Aldehyde and Ketone Photolysis," by **P. A. Leighton** (*pp.* 749–761).—Discusses absorption spectra, primary process in decomposition, secondary reactions in decomposition.

" Hydrocarbon Free Radicals in Photochemical Processes," by **H. S. Taylor** (*pp.* 763–772).—Deals with the reactions in alkyl iodides, metal alkyls, mercury-photosensitised hydrogenations and decompositions of hydrocarbons, and the photolysis of azo-compounds.

" Evaluation of Specific Reaction Rates in Chain Reactions," by **G. K. Rollefson** (*pp.* 773–781).—Considers the three main types of processes: (1) chain starting, (2) chain terminating, and (3) chain continuing.

" Secondary Processes in the Photodecomposition of NH_3 and N_2H_4," by **H. S. Taylor** (*pp.* 783–788).

"Secondary Processes in the Photochlorination of CO and H_2 " by **H. S. Taylor** (*pp* 789-794).

" Action of Optical Sensitisers on the Photographic Plate," by **G. Kornfeld** (*pp.* 795–813).—Surveys the published work dealing with the mechanism of optical sensitising of photographic emulsions, the connection between sensitising and other properties, and the mechanism of desensitising.

" Photosynthesis," by **W. M. Manning** (*pp.* 815–854).—The following sections are discussed: Measurement of photosynthesis, general description of the photosynthetic process, and the rôle of chlorophyll in the photosynthetic process. R. C. F.

4486. Photochemical Researches in the Extreme Ultra-Violet. Part VI. W. Groth and P. Harteck. *Zeits. f. Elektrochem.* 44. *pp.* 621–627, *Sept.*, 1938.—Deals with the mechanism of the H_2–O_2 reaction from a consideration of the thermal H_2–O_3 reaction. O atoms are produced by the action of the Xe resonance lines 1470 Å and 1295 Å on a flowing mixture of H_2 and O_2 at atmospheric pressure with an O_2 partial pressure of from 0·3% to 8%. The reaction products due to the action of these O atoms on the mixture are measured and compared with the O_2 partial pressure, conclusions thereby being drawn regarding the secondary processes. [See also Abstract 5305 (1937) and following Abstract]. R. C. F.

4487. Photochemical Researches in the Extreme Ultra-Violet. Part VII. K. Faltings, W. Groth, and P. Harteck. *Zeits. f. phys.*

Chem. 41. *Abt.B.* 1. *pp.* 15–22, 1938.—The absorption and photochemical decomposition of CO when irradiated with the resonance lines of Xe at 1295 and 1470 Å have been investigated. Only the shorter wave-length light causes decomposition with a quantum efficiency of 1. CO_2 and C_3O_2 are formed. The dissociation energy of the CO molecule has been obtained from the photo-decomposition. The value obtained lies between 219 and 193 kg.-cal. The photochemical reactions occurring when a mixture of H_2 and CO is irradiated with the resonance lines of Xe have also been investigated. HCHO, H_2O, and H_2O_2 are formed. The mechanism of the formation of the last two is considered, and it is supposed that this occurs through the intermediate production of HCO radicals. [See also preceding Abstract.] A. J. M.

4488. Photodecomposition of Ethyl Methyl Ketone by Wave-Lengths from 1850-2000 Å. V. R. Ells and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 60. *pp.* 2031–2036, *Sept.*, 1938.—Photodecomposition of ethyl methyl ketone in the near u.v. (largely with the 3130 Å line of Hg) leads to the production of diketones, approximately 11% of the reaction going in this way at room-temperature. The quantum yield of CO formation from ethyl methyl ketone at room-temperature with wave-lengths from 1850 to 2000 Å increases from about 0·70 to about 0·88 as the pressure decreases from 90 mm. to 0·1 mm. Diketones are formed in this region of the spectrum. The formation of biacetyl has been shown spectroscopically. The total quantum yield of ethyl methyl ketone decomposition with wave-lengths below 2000 Å is nearly one at low pressures when allowance is made for diketone formation. At higher temperatures some CH_4 is formed, but at room-temperature the principal hydrocarbons are ethane, propane and butane in approximately equal amounts. Possible secondary reactions are discussed. AUTHORS.

4489. Photography. C. E. K. Mees. *Frank. Inst., J.* 226. *pp.* 281–292, *Sept.*, 1938.—Summarises recent theoretical work and gives details of some practical developments. A. H.

***4490. Stability of Viscose Type of Ozaphane Photographic Film. A. M. Sookne and C. G. Weber.** *Bureau of Standards, J. of Research*, 21. *pp.* 347–353, *Sept.*, 1938.—Viscose Ozaphane, a new type of film with a base of regenerated cellulose sheeting, and having certain advantages for record use, was tested to determine its comparative stability. Its stability was compared with that of cellulose nitrate, and also with that of cellulose acetate, which is widely used for film-slides, and which has been found to be a very stable material for preserving records in libraries. The viscose type of film apparently is not suitable for permanent records, but does appear to have properties to recommend its use for reading-room copies that can be replaced when they become unserviceable. The stability was determined by measuring changes in its chemical and physical properties under accelerated ageing. The changes observed were increase in acidity and copper number, and decrease in viscosity, weight, and flexibility. AUTHORS.

4491. Foreign Nuclei in AgBr. Lüppo-Cramer. *Kolloid Zeits.* 84. *pp.* 340–344, *Sept.*, 1938.—The " Capri Blue " effect discovered by the author, *viz.*, the curve alterations of germless large-grained emulsions of slight sensitivity produced by certain dyestuffs, may be explained by the formation of nuclei other than those of Ag and Ag_2S which increase the sensitivity of the AgBr. The conditions are discussed, which must already be present in the emulsions, for the dyestuffs to play a similar rôle to that of the Ag-containing nuclei in ordinary emulsions or by other foreign substances in other light-sensitive systems. H. H. Ho.

4492. Photographic Sensitivity and the Reciprocity Law at Low Temperatures. W. F. Berg and K. Mendelssohn. *Roy. Soc., Proc.* 168*A*. *pp.* 168–175, *Oct.* 25, 1938.—Photographic materials show an appreciable sensitivity down to 20° K. Little change occurs when the temperature is dropped from 90° K. to 20° K. The main difference is a drop in contrast and in maximum density. No reciprocity failure occurs at temperatures of 90° K. and 20° K. It is suggested that at these temperatures the latent image is formed in two distinct stages: (*a*) an electronic process, in which the electrons are separated from the Br ions absorbing the light, and freeze into the lattice, and (*b*) an ionic process, taking place on warming up, consisting of a movement of the Ag and probably also the Br atoms. AUTHORS.

4493. Reflex Copying. L. van der Grinten. *Phot. J.* 78. *pp.* 579–583 *and* 586, *Sept.*, 1938.—The various methods that have been used for reflex copying are described and their respective advantages and disadvantages pointed out. The Retocee process of screen reflectography is also discussed. A. H.

***4494. Physical Density Comparator. M. H. Sweet.** *J.O.S.A.* 28. *pp.* 349–353, *Sept.*, 1938.—A density comparator is constructed using filtered tungsten radiation and Polaroid plates as a means for obtaining an accurate standard of comparison. In order to measure the densities of small areas of the negatives and print, high flux concentrations are used. The infra-red is filtered from the total radiation by submerging the incandescent source in a tank of water. A water-air lens is used to condense the light. The instrument permits the measurement of both transmission and reflection densities. AUTHOR.

See also Abstracts 4466, 4498, 4561.

PHOTOMETRY.

***4495. Apparatus for Testing Highway Sign Reflector Units. R. Kingslake.** *J.O.S.A.* 28. *pp.* 323–326, *Sept.*, 1938.—Describes apparatus which gives a measure of the flux reflected within a specified small cone from a reflector button when illuminated by a headlight. A rectifier photo-cell has a small hole drilled in it; the image of a projector lamp filament is formed on this hole which is of a size which represents an automobile headlight on the same scale as the distance of the button from the cell represents 62 ft. The light from the hole is collimated by a lens and falls on the button either normally or at any desired degree of tilt. The reflected light falls on the collimator and thence reaches the photo-cell. A mask in front of the cell delimits the beam to an angle of divergence of 1°. The cell is calibrated and, from the current given, the total flux reflected within the cone is measured. The author points out that the results cannot be expected to correlate well with the ordinary visual test since the latter depends on candle-power and not flux. J. W. T. W.

See also Abstracts 4561, 4564, 4567.

POLARISATION.

4496. State of Polarisation of the Wave Penetrating into the Second Medium in Total Internal Reflection. S. Gandolfo. *N. Cimento*, 15. *pp.* 139–144, *March*, 1938.—With plane polarised incident light the totally internally reflected beam is in general elliptically polarised. The connection between the ellipticities of the reflected beam and the beam penetrating into the second medium is worked out on the usual theory. Experimental test is promised. W. S. S.

4497. Spectropolarimetry. J. Rabinovitch. *Rev. d'Optique*, 17. *pp.* 161–163, *April*, 1938.—A description is given of the method put forward originally by Fizeau and Foucault for the rapid determination of the variation of rotatory power with wave-length, where the use of a prism in conjunction with originally crossed nicols between which the optically active material is placed produced a black band in the spectrum—the rotation of the substance for a given wave-length being given by the angle through which the analyser has to be turned to bring the band to that point in the spectrum. The rapidity of the method for survey purposes is stressed and its usefulness in cases where the rotatory dispersion curve is anomalous is also indicated. A. H.

4498. Theory of Photodichroïsm. S. Nikitine. *Comptes Rendus*, 207. *pp.* 331–333, *Aug.* 1, 1938.—The theory of photodichroïsm previously developed [see Abstract 2875 (1938)] is generalised by means of the hypotheses of Jablonski. The theory has been compared with the experimental results. H. G. C.

***4499. Senarmont Compensator. F. Gabler and P. Sokob.** *Zeits. f. Instrumentenk.* 58. *pp.* 301–316, *Aug.*, 1938.—The authors discuss the theory, design and adjustment of the Senarmont compensator for determining the ellipticity of polarised light. As analyser, a simple nicol and half-shade arrangements of the Schönrock and Chauvin types are considered. The precision of setting with the half-shade arrangements is calculated, allowing for the change of contrast sensitivity of the eye with brightness. W. S. S.

***4500. Measurement of Elliptically Polarised Light with the Calderon Double Plate. G. Szivessy and W. Herzog.** *Zeits. f. Instrumentenk.* 58. *pp.* 345–355, *Sept.*, 1938.—Continuing previous work on the use of a double plate for the detection of elliptically polarised light [see Abstract 3234 (1938)], the authors show how the azimuth, ellipticity and sense of rotation can be measured with the Calderon double plate. The design of the double plate to give optimum sensitivity is discussed. W. S. S.

See also Abstracts 4563, 4693.

REFLECTION, REFRACTION AND DISPERSION.

***4501. Optics of Head-Lights. J. H. Nelson.** *Journ. Sci. Instruments*, 15. *pp.* 317–322, *Oct.*, 1938.—Briefly deals with the conditions to be fulfilled when designing a lamp, the optical principles of modern mass-produced head-lamps, anti-dazzle lamps and fog lamps. R. C. F.

4502. Reflection and Transmission Coefficients of Very Thin Metallic Layers. P. Rouard. *Rev. d'Optique*, 17. *pp.* 1–10, *Jan.*; 61–69, *Feb., and pp.* 89–112, *March*, 1938.—The method is described by which the coefficients of reflection, (I), and transmission, (II), of very thin layers of the noble metals, deposited on supports of glass or quartz, have been determined. For the metals studied and for all wave-lengths, when the light is reflected in the transparent support, (I) passes through a definite minimum as the thickness of the layer grows from 0 to 10 $m\mu$. The nature of the support, the different methods of preparation, and the ageing of the layers influence the results obtained for (I) and (II), and account for the different recorded values. Comparison of experimental results with those predicted by a theory, which is developed, indicates optical constants in thin layers different from those of the metals in bulk. For Ag the divergence of these values is notable when the ratio of the thickness of the layer to the wave-length is less than 0·04. [See Abstract 2441 (1938).] W. R. A.

4503. Gas Absorption and Optical Constants of Thin Metal Foils. M. Kindinger and K. Koller. *Zeits. f. Physik,* 110. 3–4. *pp.* 237–250, 1938.—Thin metal foil is assumed to absorb considerable amounts of gas ; the number of free electrons in the metal is much increased due to ionisation of the gas atoms ; the thickness of very thin metal foil, determined by weighing, may be in error by more than 100% owing to gas absorption. The effect of gas absorption upon the optical constants of metal foil is discussed theoretically and it is shown that it is considerable for long wave-lengths and vanishes in the u.v. ; it is negligible for both thick and extremely thin films and is appreciable only for films of thickness 5 to 30 $m\mu$. Discrepancies in values of the optical constants of thin films determined by various observers are attributable in part to errors in the thickness of films as determined by weighing and in part to changes in the optical constants due to gas absorption. The correctness of these conclusions is established experimentally by results relating to the transparency of gold films of thickness up to about 100 $m\mu$ for radiation of wave-length 436 $m\mu$. J. S. G. T.

4504. Optical Constants of Very Thin Metal Films. K. Försterling. *Ann. d. Physik,* 33. 2. *p.* 132, *Sept.,* 1938.—Correction to the original [see Abstract 1169 (1938)].

4505. Abnormal Birefringence in a Compressed Transparent Substance. A. Cotton, G. Courtot and J. Guillemin. *Comptes Rendus,* 207. *pp.* 313–316, *Aug.* 1, 1938.—" Plexiglas " is transparent, has an index of refraction 1·49 and density 1·18. If it is subjected to pressure it shows, similarly to glass, immediate negative birefringence. The magnitude of it decreases with the time to a constant value and on removing the pressure a positive birefringence remains equal to the difference between the two values under pressure. This gradually dies away. H. G. C.

4506. Refractive Dispersion of Oils and Fats. Part I. V. T. Athavale and S. K. K. Jatkar. *Indian Inst. of Science, J.* 21*A.* 3. *pp.* 15–25, 1938.—The refractive dispersions of butterfats from different sources have been measured on a Pulfrich refractometer and the dispersion constants are found to be sufficiently different from those of vegetable oils to account for the characteristic colour fringes on a simple type of butyro-refractometer. It should be possible to detect adulteration of ghee by measurement of both refractive index and dispersion on a Pulfrich refractometer using the green and violet lines of the Hg arc. Mixtures of oils can be prepared to give the same refractive index as that of ghee, but it will be difficult to get the same dispersion, especially in view of the fact that oils of lower refractive index and consequently lower dispersion are usually employed for adulteration. AUTHORS.

4507. Dispersion Theory. C. Schaefer. *Ann. d. Physik,* 33. 3. *pp.* 243–248, *Oct.,* 1938.—It is shown that a result, identical in form and significance with that derived from the wave-mechanical treatment, can be obtained from classical theory if account is taken of the inter-relationship between the "characteristic frequencies", as, for instance, in a series. C. B. A.

***4508. Luminosity of Telescope Images. V. Ronchi.** *Zeits. f. Instrumentenk.* 58. *pp.* 316–321, *Aug.*, 1938.—The author summarises a number of investigations dealing with the luminosity of telescope images in relation to the sizes of the exit and entrance pupils and the magnification of the telescope. The results are not in accord with the usual theory and indicate that certain special properties of the eye are operative. W. S. S.

***4509. Position of the Exit Pupil of Telescopes. C. v. Hofe.** *Zeits. f. Instrumentenk.* 58. *pp.* 374–377, *Sept.*, 1938.—The position of the exit pupil of a telescope with respect to the observer's eye pupil affects the value of the instrument in use. The author derives an expression for the distance of the exit pupil from the eye-piece for a telescope employing two reversing lenses with condensing lenses in the two image planes. It is shown how with such a system the exit pupil may be placed in any desired position. W. S. S.

See also Abstracts 4305, 4332, 4334, 4366, 4433, 4462, 4467, 4495, 4569, 4580, 4648.

SPECTROSCOPY.

4510. Luminous Effect for the Detection of Sulphur Compounds. E. Schröer. *Zeits. f. phys. Chem.* 40. *Abt.B.* 6. *pp.* 450–454, 1938.—An account is given of a sensitive method for the detection of S by the emission of blue light from a H_2 flame into which the S compound is introduced. Experimental evidence is adduced in support of the explanation that this emission is due to S_2 molecules excited by the recombination of H atoms. The energy of excitation of S_2 coincides with the heat of recombination of $H + H$. L. A. W.

4511. Excitation of Balmer and Paschen Series of H and D by Electrodeless Discharge. H. Nagaoka and T. Mishima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 815. *pp.* 931–956, *Sept.*, 1938. *In English.*—Balmer and Paschen series were excited in a tube 15 cm. wide and 100 cm. long containing H_2 or D_2 by electrodeless discharge, using a 30 kW transformer and 0·003 μF condenser with exciting coil. A spark gap for continuous discharge with compressed air gap maintained the discharge without interruption. Sparks were examined by photographing them on a rapidly rotating film. Spectra were studied with a Steinheil GH spectrograph. Balmer series for H and D, almost free from secondary spectrum, were obtained, by proper adjustment of pressure and focusing, to *n* 25; with slightly increased pressure to *n* 37, but mixed with secondary spectrum as given by photometric curve. The electron distribution function for *n* 10 is diagrammatically shown, to illustrate the complexity of electron distribution. λ_H—λ_D from *n* 7 to 20 are given. Paschen series for H and D to high terms are described, and compared with Merrill-Wilson spectrograms of hot stars in infra-red. Accurate measurement of λ_H—λ_D for Balmer and especially Paschen series is emphasised. AUTHORS.

4512. Effect of Current Strength on Line Broadening in High Pressure Hg Discharge. R. Rompe and P. Schulz. *Zeits. f. Physik*, 110. 3–4. *pp.* 223–232, 1938.—The effect of current strength on broadening of lines 5770Å ($2^1P_1 - 3^3D_2$) and 10140Å ($2^1P_1 - 2^1S_0$) is examined; the former has a much greater temperature effect than the latter but in each case the relationship is linear. The broadening of the 5770 Å line is due to electron impact whilst that of the 10140 Å line is due to *Eigendruck* broadening. [See also Abstract 2458 (1938).] H. J. H. S.

4513. Light Intensity Distribution in High Pressure Hg Arc Discharge. F. Rössler. *Zeits. f. Physik,* 110. 5–6. *pp.* 352–359, 1938.—The light intensity of the more important lines in the high pressure Hg arc discharge is measured as a function of the distance from the axis of the discharge. The curves are similar and show a maximum on the axis. The continuous spectrum in the region of 3240 Å gives a similar distribution but shows an appreciable increase in intensity near the edges of the discharge and, in addition, the distribution is affected by current strength. An explanation of the results is attempted. H. J. H. S.

4514. Visible and U.V. Radiation of High-Pressure Hg Discharge. J. Kern. *Zeits. f. techn. Physik,* 19. 9. *pp.* 249–254, 1938.—Measurements were made of the light yield (lumen/W) and the radiation yield in the medium and long-wave u.v. for different pressures, energy consumptions and tube diameters. The light yield and radiation yield both increase with consumption (W/length of arc). Increase of pressure raises the light yield but not the radiation yield. Increase in tube dia. also raises the light yield but reduces the radiation yield. An empirical formula is derived to represent the results. W. S. S.

***4515. Improvements in Fused-Quartz Mercury Arcs. L. B. Johnson and S. B. Webster.** *Rev. Sci. Instruments,* 9. *pp.* 325–327, *Oct.,* 1938.—Five new a.c. Hg arcs between oxide-coated tungsten electrodes in fused-quartz are described and the spectral intensity of each lamp is tabulated. Several points of superiority over the familiar Hg-pool kathode types are discussed. AUTHORS.

4516. Pressure Broadening in the Wings of the Mercury Resonance Line 2537 Å. H. A. Rühmkorf. *Ann. d. Physik,* 33. 1. *pp.* 21–51, *Aug.,* 1938.—The broadening of the Hg-resonance line 2537 Å has been investigated for high pressure of the Hg vapour and under addition of N_2, O_2 and CO_2 at pressures from 1–6 atm. and of A at 1 atm. pressure. In all cases the absorption coefficient was proportional to the number of absorbing Hg atoms and to the number of disturbing particles. It follows that the broadening is produced by interaction of one Hg atom with one disturbing particle only. The comparison of the experimental results with theoretical considerations shows that the broadening of the line near the centre is caused by collisions with particles of high velocities while farther away from the centre the broadening is determined by the interaction with particles at rest. A broadening in consequence of the coupling of equal atoms (Hg–Hg interaction) can only occur in the immediate neighbourhood of the centre of the line and is therefore only of minor importance. On the high frequency side of the line occur diffuse bands whose positions depend on the nature of the disturbing gas. Their wavelengths are given. The van der Waals constants are determined from the region where the absorption coefficient is proportional to $(\nu_0-\nu)^{-3/2}$, and the optical cross-sections are calculated which show a reasonable agreement with the cross-sections computed from the broadening by collisions. L. K.

4517. Electron Temperature and Light Excitation in Gas Discharge Excited by Short and Ultra-Short Waves. W. Nöller. *Zeits. f. Physik,* 110. 5–6. *pp.* 320–329, 1938.—The intensity relation between the He lines 4121 and 4144 Å is calculated for given conditions of pressure, disposition of electrodes and exciting potential. The results are then compared with experiment for pressures of 0·8 and 6·0 mm. Hg and for excitation frequencies of 4×10^6 and 10^9 and good agreement is found. It is pointed out that the usual discrepancy between the values of electron velocity calculated from electrical data and those deduced by the optical method is due to neglecting the electron velocity distribution in the latter method. H. J. H. S.

4518. Energy Distribution in a Spectrum Consisting of Lines and Continuum. F. Rössler. *Zeits. f. Physik*, 110. 7–8. *pp.* 495–501, 1938.—The absolute intensities both of the lines and of the continuous background can be obtained by working with a spectrograph (or monochromator) of variable slit width. R. P.

4519. Effective Cross-Section for Collisions of the Second Kind in Excited Hg Vapour and Hyperfine Structure of Hg Resonance Line 2537 Å. O. Buhl. *Zeits. f. Physik*, 110. 5–6. *pp.* 395–396, 1938.—It has been pointed out to the author that the formula due to Inglis, which he applied to the determination of the h.f.s. of Hg in a previous paper [see Abstract 3247 (1938)] and which led to the conclusion that Hg^{201} has a quadrupole moment 3×10^{-25}, in fact requires a correction term when applied to a nucleus having a quadrupole moment. Recalculation using the corrected Inglis formula indicates that the two h.f.s. components of Hg^{199} (B) and Hg^{201} (C) which were found previously to have a separation of 9×10^{-3} cm^{-1}. actually coincide in position within $\pm 1 \times 10^{-3}$ cm^{-1}. ; a table of the corrected h.f.s. component separations is given. J. E. K.

4520. Hyperfine Structure Interval Rule in Indium. D. H. Tomboulian and R. F. Bacher. *Phys. Rev.* 54. *pp.* 446–447, *Sept.* 15, 1938.—Interferometric measurements on λ7182 ($5s6p\,^3P_1 \rightarrow 5s6s\,^3S_1$) and λ7276 ($5s6p\,^3P_0 \rightarrow 5s6s\,^3S_1$) of In II indicate that the separations of the state $5s6s\,^3S_1$ follow the interval rule to within the experimental error (approximately 0·05%). Perturbations by neighbouring states are negligible and there are no effects for this state due to the known electric quadrupole moment of the nucleus. The results indicate that the assumption of a nuclear magnetic moment is very successful in accounting for the observed relative separations. AUTHORS.

4521. Nuclear Spin of Iodine. Part III. S. Tolansky and G. O. Forester. *Roy. Soc., Proc.* 168*A*. *pp.* 78–103, *Oct.* 10, 1938.—Earlier measurements by Tolansky [see Abstract 5006 (1935)] upon the fine structures in the lines of the first-spark spectrum of I are extended into the u.v. region with the aid of a quartz Lummer plate interferometer. Fine structures are now known for 58 lines, 39 of which have been allocated to terms which go either to the (^4S) or the (^2D) series limit. An independent fine-structure analysis is made for both the systems and is confirmed by the aid of intercombination u.v. lines. Fine-structure interval factors are given for 13 (^4S) terms and 15 (^2D) terms. These exhibit anomalies which can be explained as arising from configuration interaction perturbation. It is shown that the nuclear coupling of the $5p^3$ electrons in I is comparable with that of the 6*s* electron. In three terms, deviations from the interval rule have been established. These are attributed to nuclear electrical quadrupole moment. The perturbation constants have been calculated, but these cannot as yet be employed to give a numerical estimate of the quadrupole moment, since the coupling constants have not yet been evaluated. [See also Abstract 197 (1936).] AUTHORS.

4522. Atomic Energy Levels of p^np and d^np Configurations. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 547–567, *July,* 1938. *In English.*—A general method is described for finding expressions for the atomic energy levels, in the case of more than two states with equal *LS*-coupling, by constructing the energy matrix. The method is then applied for p^3p and p^4p configurations, and the results are compared with experimental values. For p^5p a special method is employed to take the spin-orbit interactions into account. The variations of the parameter values of F_2, G_0, G_2 for $2p^n3p$ $(n = 1, 2, \ldots 5)$ configurations are shown graphically. The methods are then applied to d^np configurations. In this case the number of states is large, some of them arise many times, and in most cases the experimental data are incomplete. Consideration is, therefore, given chiefly to the highest multiplet states, whose terms are fully known. Each state of this multiplicity arises twice at most, so that the energy matrices are obtained without constructing the transformation matrices. Other levels are taken into account only when these terms are not sufficient to determine the parameters. Results are compared with the terms of $3d^n4p$ configurations, and satisfactory agreement between the observed and calculated values is found. N. M. B.

4523. Infra-Red Absorption Spectra of Pyrrol, Thiophene and Furane. R. Manzoni-Ansidei and M. Rolla. *Accad. Lincei, Atti,* 27. *pp.* 410–413, *April* 24, 1938.—The absorption spectra of pyrrol, thiophene and furane have been measured in the region 6–17 μ. The results are tabulated together with Coblentz's observations and with the Raman spectra of these substances. In the infra-red spectrum of thiophene appear 4 bands which have no counterpart in the Raman spectrum, 4 Raman lines to which no infra-red bands correspond while 6 frequencies occurs in both spectra. In the case of pyrrol 6 frequencies are found in both spectra, 7 frequencies are observed in only one of them. In the vibrational spectrum of furane there are 7 frequencies which belong only to the Raman spectrum alone or to the infra-red spectrum alone, 5 bands can be found in both spectra while the equivalence of 4 more Raman lines with infra-red bands is dubious. L. K.

4524. Infra-Red Absorption of Heterocyclic Compounds. J. Lecomte. *Comptes Rendus,* 207. *pp.* 395–398, *Aug.* 17, 1938.—The absorption of heterocyclic compounds has been examined between 500 and 1350 cm^{-1}. Comparisons are made between pyridine and benzene, quinoline and naphthalene, etc. H. G. C.

4525. Infra-Red Absorption Spectrum of CH_3OH. A. Borden and E. F. Barker. *J. Chem. Phys.* 6. *pp.* 553–563, *Sept.,* 1938.—The absorption spectrum of CH_3OH has been studied in the region from 2·5 to 26 μ using a grating spectrometer having a KBr fore prism. Bands observed at 3683, 2978, 2845, 2054, 1477, 1455, 1340, 1034·18 cm^{-1}. together with a broad band from 860 to 380 cm^{-1}. are typical parallel and perpendicular bands and indicate that the molecule is only slightly asymmetric. The moments of inertia obtained from the fine structure of the 1034·18 cm^{-1}. band are, $A = 35{\cdot}18 \times 10^{-40}$ gm.cm²., $B = 33{\cdot}83 \times 10^{-40}$ gm.cm²., $C = 6{\cdot}8 \times 10^{-40}$ gm.cm². The low-frequency band is probably due to the vibration of the hydroxyl hydrogen parallel to the O-H bond and perpendicular to the figure of the molecule and indicates that the OH group is not free to rotate, at least in the ground state. Some evidence of free rotation in states of high excitation is obtained. F. J. L.

4526. Infra-Red Absorption Spectra of CH_3OD and CH_2DOD. E. F. Barker and G. Bosschleter. *J. Chem. Phys.* 6. *pp.* 563–568, *Sept.*, 1938.—The absorption spectra of CH_3OD and CH_2DOD in the vapour state have been examined between 2·5 and 24 μ using a grating spectrometer having a KBr fore prism. The broadness of the band at 1040 cm^{-1}. for CH_3OD indicates that the molecule is further removed from axial symmetry than CH_3OH. The corresponding band for CH_2DOD has two components arising probably from two forms of the molecule. The deformation vibration is single in CH_3OD but has four components in CH_2DOD indicating a separation of levels for which CH_3OD is degenerate. Condensation from the vapour to liquid state modifies the frequencies of the bands considerably. F. J. L.

4527. S-H Frequency of Mercaptans. D. Williams. *Phys. Rev.* 54. *pp.* 504–505, *Oct.* 1, 1938.—The spectra of one aromatic and two aliphatic mercaptans have been studied in the region between 2·75 μ and 4·25 μ. In addition to the bands near 3·3 μ arising from the C-H linkage, absorption maxima were observed at 3·85 μ in benzyl mercaptan, at 3·83 μ in *n*-propyl mercaptan, and at 3·80 μ in *n*-butyl mercaptan. These bands are attributed to a vibration of the S-H group. The data obtained in the present study are compared with the existing Raman data and with the infra-red bands arising from the O-H group. AUTHOR.

4528. Absorption Spectra of Cyclopropane, Ethylene Oxide, Ethylene Sulphide, and Ethylene Imine in the Photographic Infra-Red. E. H. Eyster. *J. Chem. Phys.* 6. *pp.* 576–579, *Oct.*, 1938.—The absorption spectra of cyclopropane, ethylene oxide, ethylene sulphide, and ethylene imine have been investigated in the region between 7000 and 12,000 Å and the stronger bands have been assigned as third harmonics of the fundamental C-H stretching frequencies of these molecules. Rotational fine structure was not observed under high dispersion, but the well-defined band envelopes of the three asymmetric rotators provide interesting examples of these little investigated band types. AUTHOR.

4529. Spectrum of Allene in the Photographic Infra-Red. E. H. Eyster. *J. Chem. Phys.* 6. *pp.* 580–585, *Oct.*, 1938.—The spectrum of allene between 7000 and 12,000 Å has been photographed under high dispersion, the observed bands being assigned as harmonics and combinations of fundamental frequencies of the molecule. Rotational analysis of the parallel band at 11,444 Å has given $97 \cdot 0 \times 10^{-40}$ $gm.cm^2$. as the large moment of inertia. The perpendicular band at 11,017 Å has been found to be unexpectedly complicated, but was too weak for detailed analysis. It has been concluded that the dimensions in ethylene and allene are: $C\text{-}H = 1 \cdot 087$ Å, $C = C = 1 \cdot 330$ Å, $H\text{-}C\text{-}H = 116°$. AUTHOR.

4530. Infra-Red Absorption and Association in Carboxylic Acids. A. M. Buswell, W. H. Rodebush and M. F. Roy. *Am. Chem. Soc., J.* 60. *pp.* 2240–2244, *Sept.*, 1938.—The general character of the infra-red absorption spectra indicative of H bonding is discussed. Curves are shown for the absorption of the active or bonding H in acetic, benzoic and deuterobenzoic acids under various conditions. The generalisation of Venkateswaran in regard to the shift of the OH frequency is confirmed and some suggestions are made to explain the complex absorption characteristic of association in the carboxylic acids. [See Abstract 4058 (1937).] AUTHORS.

4531. Absorption Spectra and Molecular Structure. Parts II and III. S. Kato and F. Someno. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 812–813. *pp.* 905–921, *Aug.*, 1938. *In English.*—Continuing previous work [see Abstract 5347 (1937)] the absorption spectra of phenol and its derivatives and of derivatives of organic acids are investigated. In each case the spectrum is described and then the molecular structure is discussed at length. In the case of phenol it is concluded that the absorption is definitely due to the single-bonded O atom, and it is suggested that the normal and excited orbitals of O should be nearly the same for phenol and anisol. In the case of the organic derivatives the conclusion is reached that there must be some kind of interaction within the carboxyl system of bonds, also, that the normal and excited orbitals of the non-bonding electron belonging to the single-bonded O in the molecule are located close to the $C = O$ group, in which strong polarity causes the attractive interaction. A. H.

4532. Absorption Spectra of Azo-Compounds and Halochromism. T. Uémura and Y Inamura. *Chem. Soc. Japan, Bull.* 13. *pp.* 509–516, *Aug.*, 1938. *In French.*—Absorption spectra of solutions of azobenzene, disazobenzene, phenyl azo-diphenyl, azodiphenyl, benzene azo-α-naphthalene, α, α'-azonaphthalene, α, β'-azonaphthalene, and β, β'-azonaphthalene in benzene and in concentrated H_2SO_4 are recorded by the Hartley-Baly method. The results are discussed with reference to halochromism. C. B. A.

4533. Absorption Spectra of Salicylaldehyde-ethylenediimine and Related Compounds. R. Tsuchida and T. Tsumaki. *Chem. Soc. Japan, Bull.* 13. *pp.* 527–533, *Aug.*, 1938. *In English.*—Absorption spectra of benzaldehyde-ethylenediimine, *o*-methoxybenzaldehyde-ethylenediimine, salicylaldehyde-ethylenediimine and *o*-hydroxyacetophenone-ethylenediimine have been measured, and the structures of the spectra are qualitatively explained by the theories of absorption spectra of coordination compounds. The longest-waved band of salicylaldehyde-ethylenediimine as well as of *o*-hydroxyacetophenone-ethylenediimine is explained as due to intramolecular formation of a H bridge between the OH group and the N atom. In other words an absorption band of a H bond has been found in the near u.v. region. The absorption spectrum of salicylaldehyde-ethylenediimine-cobalt is explained and the steric configuration of the inner complex is thereby corroborated. AUTHORS.

4534. Absorption Spectra of Metal Complexes of 2, 2′-Dipyridyl. Part II. K. Yamasaki. *Chem. Soc. Japan, Bull.* 13. *pp.* 538–542, *Aug.*, 1938. *In German.*—Absorption spectra between 2200 and 7000 Å at room-temperature are recorded for 2, 2′-dipyridyl in hexane and in water, and for $[\mathrm{Mn}(Dip)_2]\mathrm{Cl}_2$, $[\mathrm{Co}(Dip)_2\mathrm{Cl}_2]\mathrm{Cl}$ and $[\mathrm{Co}(Dip)_2\mathrm{CO}_3]\mathrm{Cl}$ in water [(Dip) = dipyridyl]. The decomposition of $[\mathrm{Mn}(Dip)_2]\mathrm{Cl}_2$ in dilute solution is established. [For Part I see Abstract 4981 (1937).] C. B. A.

4535. Absorption Spectra of $\alpha\beta$-Unsaturated Cyclic Carbonyl Compounds and their Dihydro-Derivatives. R. G. Cooke and A. K. Macbeth. *Chem. Soc., J. pp.* 1408–1413, *Sept.*, 1938.—Quantitative measurements of the absorption spectra of a series of $\alpha\beta$-unsaturated cyclic carbonyl compounds show that the substances have two maxima of absorption, one of comparatively low intensity in the region 3120–3190 Å, the other of high intensity in the region 2260–2355 Å. The former is due to the CO group influenced by the double bond, $\mathrm{C}=\mathrm{C}\cdot\dot{\mathrm{C}}\mathrm{O}$, and the latter, to the ethenoid linkage influenced by carbonyl, $C = C\cdot\dot{C}O$. In the case of phellandral with its conjugated aldehyde group, the intensity of the $C = C\cdot\dot{C}O$ band is 8 – 11 times greater than is observed in the ketones examined. The absorption spectra of cuminal and cuminic acid are respectively in good agreement with the data of typical aromatic aldehydes and acids. AUTHORS.

4536. Absorption Spectra of 4-(*p*-Dimethylaminostyryl) pyridine Methiodide and 2 : 4-Di-(*p*-Dimethylaminostyryl) pyridine Methiodide. G. R. Clemo and G. A. Swan. *Chem. Soc., J. pp.* 1454–1455, *Sept.*, 1938.—*p*-Dimethylaminobenzaldehyde has been condensed with the methiodides of 4-methyl- and 2 : 4-dimethyl-pyridine, and the absorption spectra of the products have been plotted. AUTHORS.

4537. Absorption Spectrum of the Permanganate Ion in Crystal Lattices. J. Teltow. *Zeits. f. phys. Chem.* 40. *Abt.B.* 6 *pp.* 397–430, 1938.—The visible absorption spectrum of MnO_4' ions has been examined at the temperature of liquid H_2 in crystalline solid solution with colourless salts, and in thin layers of pure permanganate. Crystal-embedded MnO_4' ions exhibit two band systems, (I) and (II), in the green and red regions, (I) having an intensity much greater than that of (II). The position, interval and splitting-up of the bands are independent of the nature of the kations and the lattice symmetry. The broadening of the lines of (I), observed in many salts, is due to disturbance of electron terms by the environment existing at the absolute zero. The natures of the disturbing influences are indicated. In thin mixed crystals, with the same kations, (I) shifts towards longer wave-lengths with increasing space-filling of the lattice anions. (II) shows much more direction dependence than (I). In thin mixed crystals with $NaClO_4$ a wider red band exists in two directions of vibration, and a band system in the violet, which is observed in no other salt. Pure permanganate is strongly sensitive to visible light, but no sensitivity has been observed for thin mixed crystals, except KIO_3 and $KHSO_4$ with small amounts of permanganate. W. R. A.

4538. Constitution and Absorption Spectrum of HNO_3. R. Dalmon. *Comptes Rendus*, 207. *pp.* 473–475, *Sept.* 12, 1938.—The curve of molecular extinction coefficient ϵ at 3180 Å against molar concentration of HNO_3, aq. passes through a minimum at 23·6 *N*, which is attributed to the formation of N_2O_5. The curves $\epsilon = f(\lambda)$ indicate an equilibrium between two components in the system. C. B. A.

4539. Absorption Spectrum of Praseodymium Salts. A. Seidel and J. Larionov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 683–686, 1938. *In English.*—The absorption of an aqueous solution of praseodymium sulphate is examined and the results are discussed in the light of a theory, originally due to Laporte, whereby the absorption is regarded as being due to transitions from the normal term belonging to the 4*f* configuration to outer shells. A. H.

4540. Bands of H_2 Ending on the $2p^1\Pi$ Level. G. H. Dieke. *Phys. Rev.* 54. *pp.* 439–445, *Sept.* 15, 1938.—New measurements make possible a much more complete analysis of the band systems ending on $2p^1\Pi$. The constants of this state can be obtained with great accuracy and the irregularities in the Λ-doubling and perturbations traced to the interaction with the higher vibrational levels of $2p^1\Sigma$. New information is obtained about some of the states which have both electrons excited. AUTHOR.

4541. U.V. Band Spectra of Se, Te and their Oxides. Choong Shin-Piaw. *Ann. de Physique*, 10. *pp.* 173–290, *Sept.*, 1938.—Several band systems have been found in the far u.v., due to Se and Te and are attributed to diatomic and polyatomic molecules. Two systems of bands due to SeO and one due to TeO have been found in the ordinary u.v., and a rich band-spectrum due to SeO_2 and TeO_2 in visible and u.v. By comparing the spectra of the elements with those of the monoxides and dioxides, a regular variation in spectroscopic properties has been shown for molecules of the same group. Some anomalies have been found in certain cases. F. S.

4542. Vibrational Analysis for a New CuCl Band System Excited by Active Nitrogen. S. Bloomenthal. *Phys. Rev.* 54. *pp.* 497–498, *Oct.* 1, 1938.—The CuCl band spectra in the near u.v., first observed by Strutt and Fowler who used active nitrogen excitation, were photographed and classified. The wave number of any band head in this system may be calculated from the formula :—

$$\nu = 25{,}282 + [383(v' + \tfrac{1}{2}) - 2(v' + \tfrac{1}{2})^2] - [415(v'' + \tfrac{1}{2}) - (v'' + \tfrac{1}{2})^2].$$

This band system has a common lower state with five other systems in the visible, observed in absorption and analysed by Ritschl. AUTHOR.

4543. Near U.V. Band System of SnO. W. Jevons. *Phys. Soc., Proc.* 50. *pp.* 910–913, *Nov.* 1, 1938.—The note refers to the papers of Connelly on SnO and of Jevons, Bashford and Briscoe on GeO [see Abstracts 4933 (1933) and 4538 (1937)]. In the latter it was pointed out that, judged by the data for related band systems of the monoxides of group-IV (*b*) elements, Connelly's values of the anharmonic coefficients $x_e\omega_e$ were anomalous, the value 3·6 cm^{-1}. for the ground state being slightly low, and the value 1·1 cm^{-1}. for the excited state being much too low. As a result of a re-examination of Connelly's band-head data the expression

$$\nu_{\text{head}} = 29624{\cdot}9 + (582{\cdot}6u' - 3{\cdot}08u'^2 - 0{\cdot}135u'^3) - (822{\cdot}4u'' - 3{\cdot}73u''^2)$$

is now proposed for the $A \rightleftarrows X$ system, and the anomalies are thereby removed. AUTHOR.

4544. Temperature Dependence of Transition Probabilities in Absorption Spectra of Rare Earths. H. Ewald. *Zeits. f. Physik*, 110. 7–8. *pp.* 428–435, 1938.—The dependence of the intensity of absorption lines in the double nitrate of Zn and Nd on crystal direction and temperature is investigated. The transition probabilities depend in an indefinite way on the crystal direction, and also on temperature and on special term combinations ; but the total intensity for all the lines in the group studied is independent of the crystal direction and temperature. The intensity sum for the lines starting from the ground term level II increases with temperature in accordance with the Boltzmann law.

C. B. A.

4545. Test of Wave Mechanics in Molecular Spectra and Recent Developments in the Spectrum of H_2. O. W. Richardson. *N. Cimento*, 15. *pp.* 232–245, *April*, 1938. *In English.*—This paper gives a brief account of recent improvements in the determination of some of the fundamental constants connected with the states of the hydrogen molecule, both experimental and theoretical. By comparing the results it can be seen how wave mechanics has overcome the test imposed on it by the existence of the H_2 molecule. The comparison is quite impressive. It then considers some properties of the molecular ion H_2^+. Finally it describes briefly some states of a type which so far have only been recognised in the hydrogen molecule and, in particular, two more of them which have been found recently. These states are believed to have the electron in each atom excited. AUTHOR.

4546. Graphical Representation of Energy States of a Diatomic Molecule. R. Schmid and L. Gerö. *Ann. d. Physik*, 33. 1. *pp.* 70–88, *Aug.*, 1938.—A 3-dimensional coordinate system is developed for the graphical representation of the multiplicity of rotation and vibration states of diatomic molecules which is found generally to be more convenient and helpful than the use of potential curves, especially for representation of interactions between molecules such as perturbation and predissociation phenomena. The coordinates are energy, $J(J+1)$ and $b(\gamma)$, where $b(\gamma) = (b/8\pi^2 c\mu)(1/\gamma^2)$; the "term surfaces" are limited by the limiting curve of dissociation, the rotation sequence of the lowest vibration levels and by a curve giving the sequence of rotation constants as a function of the energy values of vibration levels. The application of this graphical method to the study of predissociation phenomena is illustrated with reference to the CO and earth alkali hydride spectra. J. E. K.

4547. Calculations of Lower Excited Levels of Benzene. M. Goeppert-Mayer and A. L. Sklar. *J. Chem. Phys.* 6. *pp.* 645–652, *Oct.*, 1938.—The energy of the first excited levels of benzene is calculated by the method of antisymmetrised molecular orbitals. The results predict two weak bands, due to forbidden electronic transitions, at $\lambda = 2500$ and $\lambda = 2100$ and a strong band at λ 1500. No empirical data except the C–C distance in benzene were used. [See Abstract 4460 (1937).] AUTHORS.

4548. Boric Acid Continuum Emitted by the Aureole of the Carbon Arc Light. W. Finkelnburg and H. Hess. *Phys. Zeits.* 39. *pp.* 666–668, *Sept.* 15, 1938.—Experiments are described which indicate that the " borid acid spectrum " is emitted when B and O_2 meet in the flame or in the " Aureole " of the carbon arc light. The continuum is attributed to the formation of a B–O compound, in opposition to the interpretation of Walles [see Abstract 1498 (1933)]. W. R. A.

4549. Fluorescence, Absorption Spectra and Conductivity of Aqueous Solutions of Fluorescein, Rhodamine and Acriflavin. I. C. Ghosh and S. B. Sengupta. *Zeits. f. phys. Chem.* 41. *Abt.B.* 2. *pp.* 117–141, 1938.—For solutions of potassium fluoresceinate, acid salts of rhodamine B, and acriflavin, the absorption spectra in relation to the concentration, and the output in relation to cell thickness, wave-length of emission, wave-length and intensity of exciting light and concentration of solution has been investigated. The equivalent conductivities of the solutions were also measured. The fluorescent quantum efficiency (integrated over the region 4800 to 5800 Å) is independent of the exciting wave-length and for great dilutions independent of concentration. With increasing concentration the quantum efficiency decreases rapidly. It is concluded that deactivating collisions of the second kind do not occur but that the decrease of efficiency is due to the building of non-fluorescent micelles at high concentrations. The existence of these micelles is considered to be indicated also by the results obtained for the conductivity at higher concentrations. J. E.

4550. Infra-Red Absorption and Raman Spectrum of HCl. B. Vodar, R. Freymann and Y. Ta. *J. de Physique et le Radium*, 9. *pp.* 282–286, *July*, 1938.—The absorption of gaseous and liquid HCl have been examined between 0·8 and 2·1μ. The third harmonic (between 0·9 and 1·0μ) could not be detected with 40 cm. of liquid. The second harmonic (1·23μ) is accompanied by a new band at 1·29μ which disappears

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as the temperature is raised from − 80 to + 14° C. No corresponding frequency appears in the Raman spectra. The band is probably due to chain molecules, a type of association which explains the feebleness of the Raman and the strength of the infra-red bands. H. G. C.

4551. Raman Spectra of Organic Bi-Cyclic Compounds. B. D. Saksena. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 73–100, *Aug.*, 1938.—The Raman spectra of naphthalene, decaline, tetralin, indene, *trans*-β-decalone and *trans*-β-decalol have been studied, the last two for the first time. Polarisation measurements have also been made in the case of all these compounds excepting *trans*-β-decalol. The molecular structures of decaline, tetralin and naphthalene have been studied in the light of polarisation data and the symmetries of the molecules. The results indicate a puckered structure for tetralin, and a centro-symmetric structure for naphthalene. In decaline the *cis* and *trans* lines have been separated; the observed polarisation characteristics of these forms agree with the group theory results. The determination of the values of ρ for all these substances has been made for the first time and the results are given in tables. AUTHOR.

4552. Normal Modes and Frequencies of the Sulphur Molecule. S. Bhagavantam and T. Venkatarayudu. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 101–114, *Aug.*, 1938.—The normal modes and frequencies of the sulphur molecule have been worked out on the assumption that the eight atoms in the molecule occupy the corners of a puckered octagon. There are eleven modes of which four are single and seven are doubly degenerate. Two of the former type and five of the latter type are Raman active. One is inactive in both Raman and infra-red spectra and the others are active only in infra-red absorption. The results obtained in respect of the Raman effect of sulphur are in agreement with the above conclusions. Detailed expressions are derived for the normal frequencies by postulating three types of forces, namely, primary valence, directed valence and repulsive forces. [See following Abstract.] AUTHORS.

4553. Raman Spectrum and Specific Heat of Sulphur. S. Bhagavantam and T. Venkatarayudu. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 115–118, *Aug.*, 1938.—Using the expressions derived for the vibrational frequencies of sulphur [see preceding Abstract] the force constants K_1, K_2 and K_3 referring respectively to primary valence, directed valence and repulsive forces are evaluated. The values obtained are $K_1 = 2{\cdot}309 \times 10^5$ dynes/cm.; $K_2 = 0{\cdot}903 \times 10^{-11}$ dyne cm./radian and $K_3 = 0{\cdot}06665 \times 10^5$ dynes/cm. The frequencies calculated on the basis of these constants are compared with the observed Raman lines and infra-red absorption maxima and satisfactory agreement is obtained. The specific heat of sulphur is represented as the sum of a Debye function and a number of Einstein functions associated with the various normal frequencies. The calculated values compare favourably with the observed specific heats. AUTHORS.

4554. Normal Frequencies of Phosphorous (P_4). S. Bhagavantam and T. Venkatarayudu. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 119–123, *Aug.*, 1938.—Assuming a potential energy function based on primary valence and directed valence forces, expressions are obtained by group theoretical methods for the normal frequencies of the tetrahedral molecule P_4. The numerical values of the observed frequencies are in agreement with the theoretical expressions and yield $K_1 = 1{\cdot}68 \times 10^5$ dynes/cm. and $K_2 = 0{\cdot}396 \times 10^{-11}$ dyne cm./radian for the primary valence and directed valence force constants respectively. On the assumption that this value of K_1 refers to a single bond, the oscillation frequency that is to be expected of P ≡ P molecule is calculated as 742 and compared with the value 779 obtained from band spectra. The calculated specific heat at 9° C is 19·8 cal. which is in good agreement with the experimental value, namely 22·0 cal. AUTHORS.

4555. Raman Spectrum of Diphenyl. S. K. Mukerji and S. A. Aziz. *Indian Journ. Phys.* 12. *pp.* 271–282, *Aug.*, 1938.—The Raman spectrum of molten diphenyl has been studied carefully with a view to record and assign correctly the faint Raman lines. A few new lines not observed by previous workers have been recorded by carefully suppressing the continuous background with the help of suitable filters. It is pointed out that most of the ground frequencies of benzene are also observed in the case of diphenyl and that the characteristic frequency due to the C-C binding between the two benzene nuclei is 1283 cm^{-1}. AUTHORS.

4556. Raman Effect of Ethyl Derivatives. J. Wagner. *Zeits. f. phys. Chem.* 40. *Abt.B.* 6. *pp.* 439–449, 1938.—Extending previous theoretical work on methyl derivatives [see Abstract 2913 (1938)] the author considers ethyl derivatives as valency force systems with 3 masses, *i.e.*, CH_3-CH_2-X. An exact description of the chain frequencies is only possible when the atomic weight of the substituent X is not greater than 36. The valency forces calculated from observed Raman frequencies are considerably smaller than in the case of the methyl derivatives. The deductions are discussed. L. A. W.

4557. Raman Spectra of ClO′, ClO′$_2$ and BO‴$_3$ Ions. T. G. Kujumzelis. *Phys. Zeits.* 39. *pp.* 665–666, *Sept.* 15, 1938.—A saturated aqueous solution of NaClO shows, in addition to the Raman lines of H_2O, a displacement of 713 cm^{-1}. which is assigned to the ClO′ ion. On standing for five months the solution undergoes oxidation and its spectrum now shows three lines displaced from the exciting line by 713, 802 and 935 cm^{-1}. The 935 cm^{-1}. displacement arises from the ClO′$_3$ ion. To ascertain the origin of the 802 cm^{-1}. displacement a solution of gaseous ClO_2 was examined but it gave only one strong displacement of 935 + 8 cm^{-1}. By the action of NaOH on a solution of ClO_2 a mixture of $NaClO_2$ and $NaClO_3$ obtained which gave two displacements of 802 and 935 cm^{-1}. It is concluded that 802 cm^{-1}. belongs to the ClO′$_2$. The spectrum of a solution of H_3BO_3 is also given. W. R. A.

4558. Raman Spectrum of Liquid Diborane. T. F. Anderson and A. B. Burg. *J. Chem. Phys.* 6. *pp.* 586–591, *Oct.*, 1938.—The Raman spectrum of $B_2H_6(l)$ is found to contain an isotopic triplet (ν_1) 793, 806, 821 cm^{-1}., a broad line (ν_2?) 1108 cm^{-1}. and a very intense doublet (ν_3?) 2102, 2523 cm^{-1}. as well as several weaker lines. Abnormally large values for the B-B, C-C and Si-Si bond force constants in B_2H_6, C_2H_6 and Si_2H_6 suggest that these bonds are compressed in these molecules by forces which may be associated with those which restrict internal rotation. The value of 55·3 ± 1·5 cal./deg. is calculated for the entropy of $B_2H_6(g)$ at 25°. Combined with the known heat of formation this value leads to a free energy of formation of − 30,000 ± 4000 cal. for $B_2H_6(g)$ at 25°. This large value does not truly indicate high stability, for diborane decomposes easily to form other boron hydrides. AUTHORS.

4559. Variation of Raman Spectrum of Nitrate Solutions with Kation. E. R. Laird and F. M. Plesset. *J. Chem. Phys.* 6. *pp.* 592–594, *Oct.*, 1938.—The strong Raman line from solutions of Cd, Ag and Pb

nitrates has been re-measured at varied concentrations, and the results of Grassmann confirmed, namely that the frequency shift diminishes with increasing concentration for Pb and Ag, and varies little for Cd. A qualitative explanation of this behaviour and that of $NaNO_3$ is suggested in the effect of the kations on the structure of water, and attention is drawn to the similar order of these nitrates in X-ray diffraction phenomena.
AUTHORS.

***4560. Apparatus for Raman Spectroscopy at Low Temperatures. G. Glockler and M. M. Renfrew.** *Rev. Sci. Instruments,* 9. *pp.* 306–308, *Oct.,* 1938.—An apparatus is described which permits the study of Raman spectra in the temperature range from 0 to − 180° C. Its horizontal position avoids the use of a prism needed with vertical arrangements and it is easily placed into the authors' present arrangement of light sources. [See also Abstract 1230 (1936).] AUTHORS.

***4561. Progress in Infra-Red Technique. M. Czerny and H. Röder.** *Ergeb. d. exakt. Naturwiss,* 17. *pp.* 70–107, 1938.—Developments since about 1930 are discussed under three sub-headings: (*a*) sources of radiation, (*b*) methods of detecting and measuring radiation (photographic, photoelectric and thermal, including the evaporagraphic technique), (*c*) methods of dispersion. A Bibliography is appended. D. H. F.

4562. Recent Work in Infra-Red. F. Matossi. *Ergeb. d. exakt. Naturwiss,* 17. *pp.* 108–163, 1938.—This paper is a review of infra-red research since 1930. The subjects dealt with are the infra-red spectra of single molecules and of solid bodies, the study of inter-molecular effects in liquids by infra-red methods, and certain special applications such as the scattering of infra-red radiation by powders and thin metal films. A Bibliography is appended. D. H. F.

4563. Physics in Pharmacy. R. L. McFarlan. *J. of Applied Physics,* 9. *pp.* 573–578, *Sept.,* 1938.—The applications of spectroscopy, fluorescence, colorimetry, polarisation, refractivity, photoelectricity, X-rays, and other electrical phenomena to pharmacy are described. A. J. M.

See also Abstracts 4275, 4278, 4310, 4583.

TRANSMISSION.

***4564. Spectral Transmissions of Absorbing Screens for Photometry. G. Déjardin, D. Cavassilas and R. Minangoy.** *Rev. d'Optique,* 17. *pp.* 41–60, *Feb.,* 1938.—A set-up employing a photo-cell and a single stage amplifier is described for the measurement of the spectral transmissions of light filters in the range 10000 to 3000 Å. For optical densities between 0·25 and 1·5 the accuracy varied from 0·003 to 0·010. Results are given for a number of Pt sputtered quartz plates. Comparison with spectral transmissions determined by photographic photometry shows the superiority of the present method. W. S. S.

***4565. Designation of Filters for Theatrical Lighting. D. B. Judd.** *J.O.S.A.* 28. *pp.* 390–397, *Oct.,* 1938.—The basis of this proposal is that the complete definition of the chromatic properties of filters used in illumination is transmission as a function of wave-length; an approximate definition suitable for commercial specification should, therefore, take the form of an abbreviated notation for the curve of spectral transmission. It is proposed to specify filters for theatrical lighting by a seven-digit number, the first digit of which refers to spectral transmission at the short-wave extreme of the spectrum, the second, that at some longer-wave portion, and so on throughout to the long-wave extreme. The present paper discusses choices of wave-lengths to which the digits should refer and also what range of transmission should be indicated by digit, 0, what by digit, 1, what by digit, 2, and so on for maximum usefulness of the specification. Recommended choices are presented based upon a spectrophotometric examination by **W. F. Little** and **A. E. Parker** made upon two groups of theatrical gelatins, one group of 11 pink filters and one group of 11 blue filters. AUTHOR.

See also Abstracts **4350**, **4502**.

VISION.

4566. Eye and Brain as Factors in Visual Perception. R. H. Thouless. *Nature,* 142. *pp.* 418–421, *Sept.* 3, 1938. *From Presidential Address to the British Assoc.* (*Sect. J*), *Cambridge, Aug.*, 1938.—Contrasts the " transmission theory " of vision (in which the formation of an optical image on the retina is considered to be transmitted by the optic nerve to the visual centres in the cortex and so to determine completely the impression received) with the newer theory in which perception may be likened to the construction of a chart showing isobars from information received from a limited number of stations. On this theory there is room for the individual variations which are actually found among observers in suitably designed experiments. Some of these are described and certain practical consequences which follow are mentioned. J. W. T. W.

4567. Optical Resolution and Visual Examination of Two Overlapping Photographic Images. J. K. Robertson and R. H. Hay. *Phil. Mag.* 26. *pp.* 495–501, *Oct.*, 1938.—An examination of resolving power has shown that microphometer traces of photographic diffraction images are at least 10% more effective than visual observation, the microphotometer detecting a minimum whose theoretical intensity is only a few per cent less than that of the neighbouring maxima. Evidence is given that observation of the photographic images either visually through a magnifier or by enlarged positives is nearly as sensitive a test of resolution as the microphotometer, although in these methods it is necessary to guard against a possible illusory effect. AUTHORS.

*4568. **Diving Glasses. J. Mendousse.** *Rev. d'Optique,* 17. *pp.* 113–121, *March,* 1938.—For seeing under water, watertight goggles which prevent the water from coming into contact with the eyes may be used. Alternatively corrective glasses may be worn which compensate for the almost complete loss of the corneal refraction. A form of corrective glass is described comprising a plane parallel front component and a plano-convex rear component which together with a cylindrical ring form an air cell. Design details are given and a photograph of the finished spectacles. W. S. S.

4569. Stereoscopic Drawings. J. T. Rule. *J.O.S.A.* 28. *pp.* 313–322, *Aug.*, 1938.—The principles to be applied in the production of sterographs are illustrated by a number of examples and discussion of mirror and lens stereoscopes. The problem cannot be reduced to a rigid mathematical system and the principles laid down can only be a general guide. H. G. C.

See also Abstracts **4466**, **4508**, **4509**.

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X-RAYS.

4570. Reflection Patterns of X-Rays with Crystals. T. Fujiwara and I. Takesita. *Hirosima Journ. Sci.* 8. *pp.* 297–302, *Aug.*, 1938. *In English.*—X-ray reflection patterns with the crystal face (100) of rock-salt were taken by using divergent X-rays from a point source of copper and zinc; and the same kind of reflection patterns previously obtained by H. Seemann [see Abstract 1555 (1931)] are discussed on the basis of the present experiment. AUTHORS.

4571. Effect of a Direct Electric Field on Laue Diffraction Photograms. A. Němejcová and J. Brož. *Phys. Rev.* 54. *pp.* 379–384, *Sept.* 1, 1938.—The effect of a direct electric field on the Laue photograms of silica, mica and gypsum is investigated. Under the action of the field the intensity of the Laue reflections is increased, and the central spot is made narrower. If the field is applied to the crystal through Al coatings deposited on the surface by evaporation, the narrowing of the central spot increases only up to a certain intensity of the field. If the field is applied for a longer time or with aged Al coatings the difference in the central spot, with and without the electric field, disappears. The narrowing of the spot is caused by alterations produced in the crystal lattice by the field. The phenomena are explained partly by the perfection of the lattice, partly by the shift of the positive and negative ions of the crystal and the positive metallic ions of the Al coatings, which take place in a direct electric field. C. J. B. C.

***4572. Moseley Law X-Ray Tube for Atomic Physics Laboratories. B. Sway and D. A. Wells.** *Am. Phys. Teacher*, 6. *pp.* 208–211, *Aug.*, 1938.—It is considered that the work of Moseley on the frequency of the characteristic X-ray lines of the elements is one of the classic experiments forming the dawn of atomic physics. The repetition of this experiment for demonstration purposes is made easy by the X-ray tube designed and described by the authors. The tube is of the gas type, continuously evacuated and water-cooled. The anode carries six targets of different metals and is rotatable to bring any one of the targets into action. The metals are Cr, Fe, Co, Ni, Cu and Mo. Details of the vacuum and electrical systems are given, the latter being self-rectifying. A simple camera is described and typical photographs reproduced. From these are obtained the data for the curve verifying Moseley's law. E. H. W. B.

4573. K-Spectra of As, Se and Br. M. L. Allais. *Comptes Rendus*, 207. *pp.* 450–452, *Aug.* 29, 1938.—The wave-lengths of the lines β_1, β_2 and β_3 in the K-emission spectra of As, Se and Br are measured using a spectrometer which has a dispersion of 5·9 X.U. per mm. The $\beta_1\beta_3$ doublet is clearly resolved. F. J. L.

4574. Ionisation of Air by X-Rays of Different Hardness and Different Degrees of Homogeneity up to 400 kV. W. I. Block. *Ann. d. Physik*, 32. 8. *pp.* 701–733, *Aug.*, 1938.—The ionisation due to X-rays of 200–400 kV, rendered extremely homogeneous by filtering through lead and tin, was investigated for 8 cylinders ranging from 11 to 70 cm. dia., in connection with the results previously obtained by Küstner [see Abstract 655 (1928)]. Careful regard being paid to all disturbing effects, it was found that for 380 kV, 2·9 mm. Pb+8 mm. Sn+1 mm. Cu+9 mm. Al (half-value thickness=6·6 mm. Cu) and all weaker rays, a chamber dia. of 60 cm. sufficed for the full utilisation of the carrier formation and hence for the determination of the absolute "r"-unit. For rays of 400 kV, 3·7 mm. Pb+8 mm. Sn+1 mm. Cu+9 mm. Al (half-value thickness=6·85 mm. Cu) a chamber dia. of 70 cm. was not sufficient. For the ionisation in chambers of insufficient dia. curves were obtained which extend those of Küstner in the short-wave region. The continuous displacement of the minima and maxima with change of the ray hardness and also with the degree of homogeneity, shows the laws previously found by Küstner are obeyed. Confirmation was also obtained of Küstner's explanation of the reciprocal action between photoelectrons and Compton electrons in the ionisation of air. Investigation of small chambers (thimble chambers) showed that each element of their volume furnished the same contribution to the total ionisation. It was therefore found possible to determine the true intensity distribution from point to point of a non-uniform or variable intensity radiation field. Investigation of beams of 220 and 400 kV respectively in a dispersive medium (water) showed that, in agreement with the Compton effect, the sharpness of the depth delimitation increases with increasing hardness of the beam. For two entrance fields of 25 and 94 cm^2. respectively, on changing from 220 kV, 0·5 mm. Cu+1 mm. Al (half-value thickness=1·15 mm. Cu) to 400 kV, 2·55 mm. Sn+0·5 mm. Cu+1 mm. Al (half-value thickness=5·1 mm. Cu), at 10 cm. depth in water an increase of the dosage was observed of 18 and 15% respectively. A. W.

4575. Method of Gas Analysis Based upon the Optical-Acoustic Tyndall-Röntgen Effect. M. Veingerov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 687–688, 1938. *In German.*—A method of gas analysis, based upon the phenomenon of the excitation of audible vibrations by the incidence of suitably interrupted radiation upon a solid or gas—an effect studied by Bell in 1880, and later by Tyndall and Röntgen—is suggested. Suitable apparatus is described. J. S. G. T.

See also Abstracts 4280, 4312, 4563, 4711, 4712, 4715, 4716, 4717, and 3257B. Analysis by X-Ray Diffraction. J. D. Hanawalt, H. W. Rinn and L. K. Frevel.

HEAT.

CALORIMETRY.

4576. Specific Heat-Temperature Curves of Age-Hardening Alloys. N. Swindells and C. Sykes. *Roy. Soc., Proc.* 168*A*. *pp.* 237–264, *Oct.* 25, 1938.—The changes in atomic configuration taking place during hardening affect the apparent specific heat of age-hardening alloys. Specific heat-temperature curves and hardness measurements have been obtained on five typical age-hardening alloys. The results show that in certain cases, *e.g.* the Ag-Cu and Cu-Be alloys, maximum hardness is attained when the major portion of the chemical energy associated with the supersaturated solid solution has been evolved, *i.e.* precipitation has taken place. In other cases, duralumin and Al-Cu alloys, maximum hardness is associated with segregation of the solute atoms in the parent lattice prior to precipitation. AUTHORS.

See also Abstracts 4306, 4552, 4553, 4554, 4585, 4587.

CONDUCTION.

4577. Theory of Heat Conduction. H. S. Carslaw and J. C. Jaeger. *Phil. Mag.* 26. *pp.* 473–495, *Oct.*, 1938.—Various problems involving linear or radial flow of heat are solved by a method in which the partial differential equation representing the heat flow is first multiplied by e^{-pt}, where $p>0$, and is then integrated with respect to t from 0 to ∞. Frequently the solution can then be obtained from a table of Laplace transformations, or, failing this, it may be evaluated by reduction of the inversion function. R. W. P.

See also Abstracts **4330**, **4353**, and
3118B. Heat Transfer to Boiling Liquids. E. T. Sauer, H. B. H. Cooper, G. A. Akin, and W. H. McAdams.

CONVECTION.

4578. Thermal Effects on Bodies in an Air Stream. W. F. Hilton. *Roy. Soc., Proc.* **168***A*. *pp.* **43–56**, *Oct.* 10, 1938.—Pohlhausen's equation for the temperature at the surface of a flat plate with a laminar boundary layer has been verified to within the limits of experimental accuracy. The theoretical temperature slope ($\alpha=0\cdot633$) is in excellent agreement with the experimental value found near to the leading edge ($\alpha=0\cdot636$) where the flow is probably laminar. The result near to the trailing edge ($\alpha=0\cdot504$) is consistent with the flow being turbulent in this region. The linear relation between δT and V^2 breaks down at high speeds, due to the formation of shock waves, and an inflection occurs in the curve. By measurements of total head in the wake, and by force measurements on the balance, it has been verified that this inflection is caused by a shock wave. Thus thermocouples may be used to detect the presence of shock waves, and it is suggested that by placing thermocouples on models of aeroplanes, or even on actual aeroplanes in flight, the parts giving rise to shock waves could easily be found, and modified to obtain a higher top speed. Tests were also made on a steel streamline bar at various incidences and Pohlhausen's equation has been extended to apply to this case, but a rigid verification could not be effected, due to the unknown effect of heat conduction along the metal streamline bar. It is hoped to carry out further tests on aerofoil sections made of heat insulating material, and to compare the values of n found by the present method with those found by direct experiment. Agreement is to be expected over the nose of the aerofoil where the flow will be laminar, but a difference should be found behind the point of transition to turbulent flow. A circular cyclinder placed across stream was found to be a most unsatisfactory shape for a thermometric element, since its temperature varies from nearly the adiabatic compression temperature at the front, to nearly the free stream temperature at the rear. The ideal method of measuring the temperature of a moving fluid would be to move a thermometric element of any shape with the same velocity as the fluid, but since this would usually be impracticable, the best method is to use a stationary flat plate, with the sensitive area in the region of laminar boundary layer flow. AUTHOR.

4579. Calculation of Temperatures of Strongly Heated Rods and Wires. J. Fischer. *Zeits. f. Physik,* 110. 7–8. *pp.* 397–427, 1938.—Equations are established by means of which approximate calculations can be made of the temperature distributions of rods, wires or strips when strongly heated at one end and cooled at the other, or when heated electrically and cooled at both ends. Allowances are made for heat losses by conduction, convection and radiation, and for the change in electrical resistivity with temperature. The equations, which hold good for excess temperatures of several hundred degrees, are used to solve a number of problems which serve to illustrate the scope of the suggested methods. R. W. P.

DILATATION.

See Abstracts 4309, 4354.

FUSION AND SOLIDIFICATION.

4580. Physical Chemical Properties of cis- and trans-Decahydronaphthalene. W. F. Seyer and R. D. Walker. *Am. Chem. Soc., J.* 60. *pp.* 2125–2128, *Sept.*, 1938.—Pure forms of cis- and trans-decahydronaphthalene have been prepared and some of their physical properties measured. The freezing points were found to be higher than those so far recorded. The densities and refractive indices of nine mixtures of the two forms were measured and it was shown that both these properties were linear functions of the compositions. AUTHORS.

4581. Solidification Diagram of Al-Cu Alloys. W. Broniewski, S. Jelnicki and M. Skwara. *Comptes Rendus*, 207. *pp.* 233–235, *July* 18, 1938.—Al and electrolytic Cu are melted together *in vacuo* in a h.f. induction furnace, the alloys being homogenised for 250 hr. at 500° C. and cooled to room-temperature during 75 hr. Thermal points are observed at 1034° ($AlCl_3$), 952° Al_2Cu_3, 849° (AlCu), 589° (Al_2Cu), 574°, 570°, 548° (Al_2Cu – Al eutectic), the existence of five compounds being deduced. D. R. H.

See also Abstract 4290.

TEMPERATURE.

4582. Temperature Scale and Thermionic Emission from Rhodium. H. B. Wahlin and L. V. Whitney. *J. Chem. Phys.* 6. *pp.* 594–597, *Oct.*, 1938.—When Rh is heated to incandescence in an atmosphere of air or O_2 a coating forms on its surface. This is shown by a change in the emissivity. When the temperature is increased sufficiently this coating suddenly disappears, and when the temperature is lowered it reappears. This coating is probably an activated adsorption of O_2, or an oxide of Rh. It is found experimentally that the temperature and partial O_2 pressure at which the coating disappears are related by the Clausius-Clapeyron equation: $(d \log_e P)/dT = L/RT^2$. P is the partial oxygen pressure, T the absolute temperature, and L the heat of vaporisation of the surface. The electron work function of a clean Rh surface is found to be $\phi = 4\cdot80$ V, and $A = 33$ A/cm²./degree². AUTHORS.

4583. Temperature Measurement by the Method of Reversed Lines. H. J. Hübner. *Ann. d. Physik*, 33. 1. *pp.* 52–56, *Aug.*, 1938.—The author describes a method by which the temperature of the reversal of spectral lines is obtained from the extrapolation of measurements of the brightness of the light-source under consideration. The usual continuous light source is used, but it is no longer necessary that the spectral line completely disappears. It is therefore possible to measure temperatures which are higher than the temperature of the reversing radiation. L. K.

*4584. **Thyratron-Controlled Thermostat. J. M. Sturtevant.** *Rev. Sci. Instruments*, 9. *pp.* 276–279, *Sept.*, 1938.—A relatively inexpensive thermoregulator employing a resistance thermometer and phase-shifting thyratron circuit is described. Continuous control, precise to ±0·003 °C., has been obtained in a water bath of average quality of design. AUTHOR.

4585. Properties of Gaseous He at Liquid He Temperatures. A. van Itterbeek. *J. de Physique et le Radium,* 9. *pp.* 313–318, *Aug.,* 1938.—The general history of the properties of He at low temperatures is given with special reference to the specific heat. Brief details are then given of the specific heat determination by measurement of the velocity of sound in the gas. The apparatus is illustrated but has been described elsewhere. The importance of the new conceptions of the de Broglie waves in this connection, and also the Bose-Einstein statistics is emphasised. Values for the viscosity were obtained by means of the Maxwell disc, and they were also calculated theoretically. The results are in very good agreement with the theory of Uehling. Curves are given showing that for O_2, H_2 and He at these temperatures the viscosity is sensibly independent of the pressure, and also for O_2 and H_2 at ordinary temperatures and low pressures. These results are considered to verify Maxwell's law of distribution of velocities and the variation with the square root of the absolute temperature. E. H. D.

THERMOCHEMISTRY.

4586. Heat of Combustion of Styrols. W. v. Luschinsky. *Zeits. f. phys. Chem.* 182. *Abt.A.* 5. *pp.* 384–388, 1938.—The heats of combustion of monostyrol and of two different polystyrols have been measured, using the method of Roth. Polystyrol A is obtained by the polymerisation of monostyrol by heating at 180° C. for 6 hr. and polystyrol B is obtained from polystyrol A by fractional separation. The values obtained for the heats of combustion are 1045·4 kg.cal./mol. for monostyrol, 1034·8 kg.cal./mol. for polystyrol A and 1031·6 kg.cal./mol. for polystyrol B. Viscosity measurements were also made to determine the degree of polymerisation of these products. On the grounds of energy changes on polymerisation it is concluded that the C–C linkage in the polystyrols is weaker than in a normal molecule and this finding is compared with a similar result in the case of ethylene oxide and polyethylene oxide. G. G.

4587. Heat of Formation and Specific Heat of Chromium Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 819. *pp.* 1001–1009, *Sept.,* 1938. *In English.*—The mean specific heats of chromium nitrides were measured by the ice calorimeter over three temperature intervals: 0°∼99·5° C., 0° C.∼325·7° C. and 0° C.∼511° C. and the equations of the true specific heats within the limit of these temperature intervals were obtained.

$$\mathrm{Cr_2N}: \; C = 0\cdot150\,7 - 1\cdot165\,4 \times 10^{-5}T = 1\cdot253\,4 \times 10^{-7}T^2.$$
$$\mathrm{CrN}: \; C = 0\cdot209\,6 - 2\cdot328 \times 10^{-4}T + 3\cdot939 \times 10^{-7}T^2.$$

By using these values, the heats of formation of chromium nitrides were computed from their dissociation pressures measured at high temperatures. The results obtained are as follows: $2\mathrm{Cr} + \mathrm{N} = \mathrm{Cr_2N} + 26340$; $\mathrm{Cr} + \mathrm{N} = \mathrm{CrN} + 28260$. [See Abstract 2943 (1938).] AUTHOR.

4588. Theory of Uniform Flame Propagation. J. B. Zeldovich and D. A. Frank-Kameneckij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 693–697, 1938. *In English.*—Of the existing theories of flame propagation, only that of Lewis and v. Elbe [see Abstract 4247 (1934)] takes into account the kinetics of the chemical process, and they assume that up to a given temperature of ignition no reaction occurs. Actually the reaction velocity is not an explicit function of time, but of the temperature and concentration of the reactants. The manner in which it depends on the time and on the distance from the flame front cannot be obtained before integrating the equation for propagation, and the resulting expression must, in particular, contain the required velocity of propagation. A general method of solving the complex differential equations involved is now suggested. H. H. Ho.

4589. Thermal Explosion of N_2O. J. B. Zeldovich and B. I. Jacovlev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *p.* 699, 1938. *In English.*—The rapid increase of the velocity of decomposition of N_2O with temperature, as well as the exothermic character of this reaction, has indicated the assumption that after the temperature and, accordingly, the rate of heat liberation had grown sufficiently high, the decomposition of N_2O should proceed with self-ignition in an explosive manner. Experiments have confirmed this assumption, the self-ignition being accompanied by a blue flame and sharp rise in pressure. The self-ignition limit (data for which are included) has been calculated on the Frank-Kameneckij theory [see Abstract 3764 (1938).] H. H. Ho.

4590. Combustion of Explosives. A. F. Belajev. *Acta Physicochimica*, 8. 6. *pp.* 763–772, 1938. *In English.*—A theory of the combustion of explosives is based on the following assumptions: (1) the combustion takes place in the gaseous phase; (2) during the energy transfer to the surface layer of an explosive which, under the given conditions, is capable of combustion, the energy is used up chiefly in the evaporation of the explosive. In the more volatile explosives a stable state of combustion in the gas phase is attained more readily, and the production of detonation is more difficult than for the less volatile ones. A. J. M.

4591. Hydrodynamical Theory of Detonation. H. Langweiler. *Zeits. f. techn. Physik*, 19. 9. *pp.* 271–283, 1938.—The hydrodynamical theory of detonation, due to Chapman and extended by Becker is briefly, reviewed. Theories hitherto proposed are unsatisfactory in that they indicate that the products of detonation have a velocity in the direction of propagation of the advancing detonation front and this velocity is not considered in discussing the velocity of the complete system. The author develops a theory of detonation which does not necessitate the introduction of the notion of detonation temperature but is based upon directly measurable constants. The theory leads to a new definition of shattering power. The results obtained are applied to the case of trinitrotoluene. J. S. G. T.

See also Abstracts 4342, 4349, 4595.

THERMODYNAMICS.

4592. Complete Diagram of State of Binary Systems with Vapour Pressure Maxima. Part II. E. Jänecke. *Zeits. f. phys. Chem.* 182. *Abt. A.* 6. *pp.* 413–420, 1938.—The equilibrium diagrams for binary mixtures of which the constituents are isomorphous, and which show a minimum melting point are given and discussed. [For Part I see Abstract 3777 (1938).] A. J. M.

4593. Classification of State of Gaseous He, Ne and A. R. A. Buckingham. *Roy. Soc., Proc.* 168*A. pp.* 264–283, *Oct.* 25, 1938.—The problem of deriving the form of the interaction of rare gas atoms from their observed second virial coefficients is attacked by the method introduced by Lennard-Jones, using the classical equation of state and for

the interaction energy $E(r) = \lambda r^{-s} - \mu r^{-t}$. The method of calculation used by Lennard-Jones for He, Ne and A, assuming λ and μ constant, has been modified and then extended to allow for a possible slow variation of λ with r. The bearing of the results upon the true interaction of He atoms is discussed, mainly in relation to the accuracy of the Slater field. For Ne and A it is emphasised that an unambiguous determination of the interaction energy requires an accurate knowledge of the properties of the crystalline form of these elements. The description of the repulsive potential by analytic expressions, such as $be^{-r/\rho}$ and $b_1 r^7 e^{-r/\rho_1}$, is considered, and parameters deduced which give the best correlation of gas and crystal data, on the assumption that the above equation and kindred forms are valid for the interaction of neighbouring atoms only in the crystals.
AUTHOR.

4594. Critical Temperature. I. Traube. *Faraday Soc., Trans.* **34.** *pp.* **1234–1235,** *Oct.*, **1938.**—The usual definition of the critical temperature as that temperature at which the liquid and the gas have the same density is criticised on the basis that both phases exist above this temperature. A number of references are cited in favour of this and the author's suggestion of two kinds of molecules, " gasons " and " fluidons ", is briefly developed. This new theory is said to explain the deviations from the Andrews-van der Waals theory observed by so many workers. E. H. D.

4595. Solution of Ions in Water. D. D. Eley and M. G. Evans. *Faraday Soc., Trans.* **34.** *pp.* **1093–1112,** *Aug.*, **1938.**—The authors consider the entropy changes which accompany the solution of a gaseous ion in water and give a thermodynamic equation, which represents the whole process. In it account is taken of the appropriate partition functions, the translational entropy of the ion in solution and the entropy of the ion in the gas phase. G. G.

4596. Thermodynamic Properties of Methyl Bromide. C. J. Egan and J. D. Kemp. *Am. Chem. Soc., J.* **60.** *pp.* **2097–2101,** *Sept.*, **1938.**—The results of a calorimetric investigation on condensed CH_3Br between 15° K. and the boiling point 276·66 ± 0·05° K. are given in detail. A transition occurred in the solid at 173·75 ± 0·15° K., with a heat of transition of 113·4 ± 1 cal./mol. Other measurements made were: melting point 179·44 ± 0·05° K., latent heat of fusion 1429 ± 2 cal./mol., latent heat of vaporisation 5715 ± 6 cal./mol., density of CH_3Br gas at 298·10° K. and 1 atm. pressure 3·9739 ± 0·0009 gm./l. The results of vapour pressure measurements on the liquid were represented by the equation $\log_{10} P_{(\mathrm{Int.cm.Hg})} = -(1541{\cdot}437/T) + 8{\cdot}49274 - 0{\cdot}00424740T + 1{\cdot}7599 \cdot 10^{-6} T^2$ over the range 203 to 278° K. (0° C. = 273·10° K.). The entropy of CH_3Br (ideal gas) at the boiling point and 1 atm. was calculated from the calorimetric data and found to be 57·86 ± 0·10 cal./mol. deg. At 298·10° K. the entropy was 58·61 cal./mol. deg. The corresponding spectroscopic values for the entropy are 57·99 and 58·74 cal./mol. deg. S. W.

4597. Thermodynamics of HCl in Dioxane-Water Mixtures from E.M.F. Measurements. Part V. H. S. Harned and J. G. Donelson. Part VI. H. S. Harned and C. Calmon. Part VII. H. S. Harned, J. G. Donelson and C. Calmon. *Am. Chem. Soc., J.* **60.** *pp.* 2128–2135, *Sept.*, 1938. [See also Abstract 1689 (1938).]

4598. Exchange of Deuterium Between CH_3OH and D_2O. J. O. Halford and B. Pecherer. *J. Chem. Phys.* **6.** *pp.* **571–575,** *Oct.*, **1938.**—New measurements of the equilibrium in the exchange reaction between methanol and heavy water, in conjunction with data in the literature, are considered in relation to the vibrations of the hydroxyl group, including the torsional degree of freedom. An interpretation is presented which allows for a torsional frequency of 250 cm^{-1}., a value which is shown to be in reasonable agreement with the entropy from thermal data. AUTHORS.

See also Abstracts 4309, 4639.

VAPORISATION AND CONDENSATION.

***4599. Plate Efficiency of Fractionating Columns. D. B. Keyes.** *Univ. of Illinois Eng. Exp. Sta., Circ. No.* 35. [14 *pp.*], *July* 8, 1938.—The author briefly reviews previous work on column design and discusses the fundamental factors involved in the determination of plate efficiencies. Entirely theoretical. S. W.

4600. Evaporation of Water into Quiet Air. B. F. Sharpley and L. M. K. Boelter. *Indust. and Engin. Chem.* 30. *pp.* 1125–1131, *Oct.*, 1938.—The evaporation from a pan of 1 ft. dia. of distilled water into quiet air at 53% humidity was measured for water temperatures between 63° and 93° F. The surface of the water was at the level of the surroundings. In the critical region, corresponding to a water temperature of 69·4° F, the buoyant effects of the mixture at the water surface and far away are equal. The unit evaporation rate above the critical region, in lb./ft^2./hr. may be expressed by the equation: $e = -0{\cdot}024 + 65(c_{vw} - c_{v}\ )$. Below the critical region the results may be expressed approximately by the equation: $e = 18{\cdot}75(c_{vw} - c_{v_\infty})$, where c_{vw} is the concentration of water vapour on the gas side of the gas-liquid interface and c_{v_∞} is the concentration of the water vapour in the atmosphere far from the pan, both in lb./ft^3. A tentative correlation with thermal free convection data has been accomplished.

4601. Evaporation from Free Water Surface by Perpendicular Air Stream. M. C. Molstad, P. Farevaag and J. A. Farrell. *Indust. and Engin. Chem.* 30. *pp.* 1131–1138, *Oct.*, 1938.—Circular water surfaces of areas ranging from 0·05 to 0·37 ft^2. have been subjected to a perpendicular air stream having velocities from 3 to 15 ft./sec. (corresponding to mass velocities, G, of approximately 800–4000 lb./ft^2./hr.). Tests at prevailing room temperature and humidity and at the lower velocities gave evaporation coefficients (k' = lb. evaporated/ft^2./hr./unit humidity difference) which were about 50% greater than the accepted coefficients for evaporation of water to an air stream flowing parallel to the surface. The coefficients were found to fall on a line having the equation: $k' = 1{\cdot}42\ G^{0.37}$. The heat transfer coefficient in this case of forced convection is given as $h_c = 0{\cdot}37\ G^{0.37}$. Tests with air streams at 125°, 175° and 225° F. gave the same evaporation coefficients as the tests at room temperature. Coefficients in still air were only about 2% of those at the lowest air velocity. In a limited number of drying tests on Celotex insulating board, the evaporation coefficients during the constant rate period were substantially the same as those for water under the same conditions.

See also Abstracts 4281, 4282.

ACOUSTICS.

4602. Dunkerley's Frequency Formula. E. Jouguet. *Comptes Rendus,* 207. *pp.* 413–417, *Aug.* 22, 1938.—If a vibrating system is subjected to certain controls, and to forces possessing a potential, and if the vibrating masses are changed from m_1 to m_2 then to $m_1 + m_2$, the corresponding frequencies of the system f_1, f_2 and F, will be related by $\frac{1}{F^2} \geq \frac{1}{f_1^2} + \frac{1}{f_2^2}$. The sign for equality gives Dunkerley's formula. Examples dealing with torsional vibrations, vibrations of loaded strings and critical speeds of a bent shaft are employed to show that the inequality often borders on equality, and that the formula is in many cases sensibly exact. This is due to the small amount of variation of a function when in the neighbourhood of its maximum. G. E. A.

4603. Equivalent Lengths and Length Corrections in Acoustic Systems. F. H. van den Dungen. *Rev. d'Acoustique,* 7. *pp.* 1–19, *Jan.–March,* 1938.—The lengths referred to are those of the equivalent cylindrical pistons of air in the necks of resonators. The author investigates approximate values of the length corrections, using a principle given by Rayleigh. This leads to expressions that supply higher and lower limits for the frequency of the fundamental of the resonator, and consequently to lower and higher limits for the equivalent length or the correction. The cases of the pipe closed at one end and other forms of resonator are dealt with, and arithmetical values are found for a spherical resonator with cylindrical neck, and the limits found are compared with those obtained from Rayleigh's formula. G. E. A.

4604. Maintenance and Stabilisation of Singing Flames. Z. Carrière. *Rev. d'Acoustique,* 7. *pp.* 20–36, *Jan.–March,* 1938.—The form of the jet and its end-pieces used in producing singing flames is shown. It has a listening device in the form of a stethoscope. The following results are given. The singing flame is maintained and stabilised by an internal wave in the feed-tube, but no nodes or loops have been observed. As the frequency of the flame depends chiefly on the speed of flow of the gas near the diaphragm which causes the note, all disturbances which set up turbulent flow will alter or suppress the note. The tendency to sound is due to gaseous whirls, generated at the edge of the diaphragms used, which change into ring vortices, carried on by the gas, equidistant in time and space, and invisible below the blue edge of the flame. The height of this edge is determined by the first maximum of a Bessel function of high order which represents the internal expansion of a conical jet of gas. This is the first fringe of the flame evoked by the arrival of a ring vortex. After this the conical form no longer persists, and the fringes move vertically at nearly constant speed. The sudden and periodic break-up of the cone at the arrival of successive rings explains the localisation of the sound in the blue edge. This edge source reacts back on the diaphragm, from which may be explained various stabilities according as the gas is lit or not. Two forms of pseudo-singing flames are described which exhibit no stratification. In one case the author found, by stroboscopic means, fringes of frequency 9139. G. E. A.

4605. Motion of Loaded Vibrating String. D. N. Sen and R. Kumar. *Calcutta Math. Soc., Bull.* 30. *pp.* 1–4, *March,* 1938.—Mathematical. When a string is loaded symmetrically at *n* points, the loads diminish the frequency except in the case of the normal modes of order $k(n+1)$, when the points where the masses are placed become nodes (k = a constant). It is also shown that the disturbed frequencies may be made to approach the undisturbed ones by suitable loading. G. E. A.

4606. Velocity of Sound in Liquid Helium. J. C. Findlay, A. Pitt, H. G. Smith and J. O. Wilhelm. *Phys. Rev.* 54. *pp.* 506–509, *Oct.* 1, 1938.—The velocity of sound in liquid He under its vapour pressure has been determined by a supersonic method over a temperature range from 4·22° K to 1·76° K. From the measurements obtained, the compressibility of the liquid He has been computed. At temperatures not too close to the λ-point, the values are in fair agreement with those estimated from thermodynamical considerations, but the expected discontinuity at the λ-transition has not been observed. AUTHORS.

4607. Velocity of Sound in Copper. G. E. Allan. *Phil. Mag.* 26. *pp.* 609–614, *Oct.*, 1938.—Reference to tables shows that the velocity of sound in Cu varies from 3553–3984 m./sec. The velocity in a specimen of very pure Cu is measured by the monochord method and a mean value of 3846 m./sec. at 14·6° C is obtained but after annealing the value falls to 3730 m./sec. The temperature coefficient is small (velocity = 3852 m./sec. at 0° C. and 3815 m./sec. at 100° C.). H. J. H. S.

4608. Supersonics. E. Baumgardt. *Rev. d'Acoustique*, 7. *pp.* 39–72, *Jan.–March*, 1938.—Conclusion of critical analysis of papers published in 1935–6. [See Abstract 3333 (1938).]

4609. Total Reflection of Supersonic Waves. S. I. Kretschmer and S. N. Rschevkin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 17–20, 1938. *In English.*—It is recalled that in the case of total reflection of a sound wave at the boundary of two media, partial penetration of the sound into the second medium takes place. The nature of the waves in the second medium is discussed mathematically and it is concluded that waves travel parallel to the surface of separation, decreasing in amplitude as distance from this surface is increased. The more the angle of incidence exceeds the critical angle the more rapidly the amplitude decreases with penetration into the second medium. Total reflection of supersonic waves at a vaseline oil-salt solution interface is studied experimentally, photographs being shown which confirm the above conclusions. K. M. C.

4610. Diffraction of Light by Superposed Supersonic Waves. M. A. G. Rau. *Indian Acad. Sci., Proc.* 8A. *pp.* 6–7, *July*, 1938.—Pictures are reproduced of the diffraction patterns obtained with light that has traversed a system of superposed supersonic waves set up in a liquid. Besides the presence of the combination lines, the pictures clearly show the characteristic manner in which their number and intensities depend upon the intensity of the original spectral orders. AUTHOR.

4611. Diffraction of Light by Supersonic Waves. K. N. Rao. *Indian Acad. Sci., Proc.* 8A. *pp.* 124–134, *Aug.*, 1938.—The results of Raman and Nath in their general theory of the diffraction light by supersonic waves at normal and oblique incidences are shown to be in complete agreement with those of van Cittert for the case of normal incidence [see Abstract 4128 (1937)] and also with those obtained by extending van Cittert's method to the case of oblique incidence. The amplitude function for the latter case is developed *in extenso* in a series of Bessel functions. The expression for the intensity with normal incidence in the case of N systems of sound waves is $|J_{n_1}(\sigma_1 z)\, J_{n_2}(\sigma_2 z) \ldots J_{n_N}(\sigma_N z)|^2$.

where $n_1, n_2, \ldots n_N$ are the orders excited. This result is the same as that which has been obtained by E. Fues by applying the simplified Raman-Nath method to the case considered. AUTHOR.

*4612. **Circuit Details for a Small Supersonic Oscillator of the Piezoelectric Type. W. C. Bosch and W. G. Allée, Jr.** _Am. Phys. Teacher_, 6. _pp._ 272–273, _Oct._, 1938.—A compact 220-kc. supersonic oscillator, using two 250-W triodes in a self-rectifying parallel-feed Hartley circuit, is described and circuit constants are given. The quartz crystal is immersed in transformer oil and the mound, 4 to 5 cm. high, raised on the oil surface at maximum power output indicates that sufficient supersonic energy is available for many experimental uses. AUTHORS.

4613. Measurement of Absorption in Rooms with Sound Absorbing Ceilings. J. R. Power. _Acoustical Soc. of America, J._ 10. _pp._ 98–101, _Oct._, 1938.—Serious difficulties have been encountered in attempts to measure the absorption coefficients of sound absorbing ceilings in large offices. An analysis of the sound field is made and it is concluded (1) that the reverberation time formula is usually invalid if the absorption is concentrated on one surface of the room, (2) that the energy density formula is not subject to such a restriction and (3) that under such conditions there is no apparent field method of determining the absorption coefficient that will serve as an accurate check on laboratory measurements. AUTHOR.

4614. Hearing during Noise. Physiological Effect. Y. Rocard. _Rev. d'Acoustique_, 7. _pp._ 37–38, _Jan.–March_, 1938.—When speech is transmitted while noise is present, the loudness of speech required for clearness of hearing increases with the loudness of the noise in such a way that when these are plotted against each other the curves of equal distinctness approach each other for high values of loudness. G. E. A.

4615. Noise Measurements aboard Ship. H. A. Simms. _Engineer_, 166. _pp._ 345–346, _Sept._ 23, 1938. _Paper read before the Am. Soc. Naval Engin._—The procedure employed by the U.S. Naval Engineering Experiment Station in making noise measurements on board ship is described and explained. In enclosed spaces readings are taken with the microphone in a number of different positions in order to eliminate the effects of stationary waves. The importance of proper frequency weighting networks in total noise measurements is pointed out. K. M. C.

4616. Absorption of Sound in CO_2 and Other Gases. V. O. Knudsen and E. F. Fricke. _Acoustical Soc. of America, J._ 10. _pp._ 89–97, _Oct._, 1938.—Sound absorption measurements in pure CO_2 at 1 atm. and 22° C. have been conducted which, together with measurements by others, confirm the collision theory of anomalous absorption as developed by Einstein, Kneser and others. The absorption coefficient is appreciable at frequencies as low as 2000 $\sim$, and increases to a maximum of 0·317 per wave-length at 77,000 $\sim$. This maximum is higher than values obtained by previous workers, and indicates that both the deformation and symmetrical valence vibrations participate in the exchanges between translational and vibrational energy. Small impurities, as water or alcohol vapours, affect the absorption greatly; the entire absorption band is shifted to higher frequencies. Measurements in mixtures of CO_2 in O_2 and CO_2 in N_2 indicate that neither the O_2 nor N_2 is appreciably excited by collisions with CO_2. Measurements in CS_2 reveal an absorption similar to that for CO_2 except that the absorption begins at about 10,000 $\sim$.

In mixtures of CS_2 and O_2, the observed absorption at frequencies below 10,000 ~ is accounted for by assuming that only the vibration of O_2 molecules is excited by collisions with CS_2 molecules; at higher frequencies the CS_2 molecules also are excited, principally by collisions with other CS_2 molecules. AUTHORS.

***4617. Absolute Sound Measurements in Liquids. E. Klein.** *Acoustical Soc. of America, J.* 10. *pp.* 105–111, *Oct.*, 1938.—The fundamental problem of absolute sound measurements in liquids is discussed. Regarding acoustic determinations, reference is made to certain inherent differences between air and water. An outline is presented of three methods now available for sound determination. A modified radiation pressure apparatus is described which permits a dual check of the basic measurements involved, and at the same time makes possible microphone calibration for secondary standards. [See also Abstract 2107 (1938).] AUTHOR.

***4618. Adjustable Tuning-Fork Frequency Standard. O. H. Schuck.** *Acoustical Soc. of America, J.* 10. *pp.* 119–127, *Oct.*, 1938.—A portable tertiary frequency standard, adjustable over a small range, is described. The frequency determining element is a tube-maintained tuning fork, adjustment of whose frequency over a relatively small range is accomplished by changing the position of movable weights on the prongs. Calculations are simplified by the design of the fork, which permits the assumption of lumped constants. The weights may be moved while the fork is running without interfering with its operation. Indication of their position is by means of a pointer reading on a scale graduated directly in frequency units. A precise method of calibration is given. Mechanical arrangements are described for obtaining a uniformly spaced scale, and the possibility of using such a scale in correcting for the temperature coefficient of the fork material is discussed. The relative accuracy of such a fork is greater, the smaller the range of frequency adjustment. In the present development, adjustment may be made over a range of plus and minus 3% of the mean frequency, that is, a musical interval of one semitone, or 100 cents total change. Incorporation of this fork in the chromatic stroboscope has resulted in considerable simplification as well as an increase in the reliability of the instrument. AUTHOR.

See also Abstracts 4330, 4575, 4585, and
3258B. Experiments on Supersonic Radiation. A. Giacomini.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

4619. Effects of Stray Admittances in Four-Arm Bridge Networks. N. F. Astbury. *Phil. Mag.* 26. *pp.* 507–519, *Oct.*, 1938.—When one or more of the arms of a bridge consists of two or more components in series, the stray admittances between the junctions of these components affect the conditions of balance. Two fundamental results are obtained, referring to cross admittances between junctions in adjacent arms and in opposite arms. It is shown that in general the equations of balance are unsymmetrical, and that in consequence the presence of such admittances is shown by a change in balance point when the components in any one arm are interchanged. For certain cases of circuit symmetry the effects vanish. The lack of symmetry distinguishes the effects from those arising from capacitances to earth. The application of the results to certain practical cases is considered, and suggestions as to treatment by circuit arrangement and by screening are made. AUTHOR.

4620. Effect of Condenser Leads in Lecher Wire Measurements. H. Slätis. *Ann. d. Physik*, 32. 8. *pp.* 734–742, *Aug.*, 1938.—The Morton-Drude-Coolidge formula for the capacity K of a condenser located in a Lecher wire system between two bridges at distances x_1 and x_2 is modified by consideration of the effect of the condenser leads. It thus becomes:

$$\frac{4\pi}{\lambda^1}\left[\mathrm{K}+\frac{\delta}{2\log d/\mathrm{R}}\right]\log d/\mathrm{R}=\cot\frac{\pi\,(x_1-\delta)}{\lambda^1}+\cot\frac{\pi(x_2-\delta)}{\lambda^1},$$

where λ^1 is the half-wave-length of the oscillations, d and R the distance apart and the radius of the Lecher wires and $\delta = \mathrm{L}_{12}^2/(\mathrm{L}_{22}.4\log d/\mathrm{R})$. δ is an expression which takes account of the eddy currents induced in the condenser lead wires, L_{22} being the self-induction coefficient of the eddy current path in one lead wire and L_{12} the mutual-induction coefficient of this path and the corresponding Lecher wire. A. W.

***4621. Electronic Null Detector for Impedance Bridges. H. W. Lamson.** *Rev. Sci. Instruments*, 9. *pp.* 272–275, *Sept.*, 1938.—A kathode-ray tube containing two perpendicular pairs of electrostatic plates is utilised as a simple detector of balance in a.c. bridge networks. The pair which produce the horizontal or sweep motion of the spot across the screen are energised by the same generator which energises the bridge. The output from the detector terminals of the bridge is provided with a sufficient amount of amplification and then applied to the vertical deflecting plates. Suitable equipment is provided for varying at will the phase relation between the sweeping e.m.f. and the out-of-balance e.m.f. of the bridge. The figure traced on the screen of the tube is, in general, an ellipse and by proper choice of the phase relationship independent indications of the progress towards balance of the adjustments of the two components of the impedance are provided. Thus, as one example, the quadrature control is made to tilt the ellipse while the direct control closes it into a straight line. The direction of the tilt indicates whether the control is off balance in a positive or a negative direction. With this detector balance is reached with no more than two adjustments of the controls. The detector is not damaged by overloading, which merely produces a distorted ellipse in the initial stages. T. I. J.

See also Abstract 4644.

CONDUCTION AND DISCHARGE IN GASES.

4622. Wall Potential in the Diffusion Column. W. Funk and R. Seeliger. *Zeits. f. Physik*, 110. 3–4. *pp.* 271–276, 1938.—A modification is introduced into the Schottky theory of the diffusion column. In this theory the electron concentration at the tube wall is set at zero and this leads to an infinite value for the wall potential. The boundary condition introduced is that the wall electron current is equal to the unrectified electron current. This theory is worked out in detail and it is shown that a finite value of the wall potential is obtained, leading to reasonable values for the thermal inhomogeneity of the column. [See also Abstract 759 (1934).] J. E. R.

4623. Luminous Appearances and Sinusoidal Electric Oscillations of the Flash Discharge. R. Ricamo. *N. Cimento,* 15. *pp.* 149–157, *March,* 1938.—In a previous communication experiments on a type of flash discharge which shows the " Raumsäule " (positive column), and the conditions for the production of such a discharge were described. The properties of this type of discharge are studied. Sinusoidal electric oscillations of high acoustic frequency are generated and are investigated with a kathode-ray oscillograph. C. J. B. C.

4624. Glow Discharge Relation. Y. Kasiwagi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 568–585, *July,* 1938. *In English.*—Recent experiments on the glow discharge in N_2 indicate a simple relation [see Abstract 2967 (1938)]. From measurements made for all possible combinations of 11 kinds of metallic electrodes, the terms of this relation are interpreted, and, by applying to the relation the generalised form of Aston's empirical equation, a meaning is found for the set of curves representing the relation between the current density and the vertex distance. From the relation and the data obtained, simple interpretations are proposed and discussed for sputtering, for the Crookes dark space, and for the appearance of the dark space and negative glow. N. M. B.

4625. Excess Temperatures in the Glow Discharge. H. Fischer. *Zeits. f. Physik,* 110. 3–4. *pp.* 197–213, 1938.—It is shown that considerable local excess temperatures exist in the glow discharge. The effects of these super-temperatures in a discharge in He at various pressures, on the characteristic quantities of the discharge, have been investigated and determined. The magnitudes considered are the current density, the kathode fall and the length of the discharge space. From the variations of these quantities a statement is made on the ionic mobilities and the dependence of the γ-coefficient on the ionic velocity v^{+}. In the discharge in He it was found that $v^{+} > b^{+} \cdot E$. In no case did the $\sqrt{E}$ law hold. An increase of γ with the ionic velocity could not be determined. The correctness of the temperature determinations and corrections were tested experimentally. G. O. B.

4626. Impulse Transference in Ionisation by Canal Rays. R. Koops. *Ann. d. Physik,* 33. 1. *pp.* 57–69, *Aug.,* 1938.—The total ionisation in H_2 and D_2 produced by H and D canal rays is measured and found always to be greater in D_2 than in H_2. The difference in ionisation is measured for different canal-ray energies and expressed as a percentage of the total ionisation. Down to 2000 eV the absolute difference in total ionisation is constant. It is calculated how much more energy is required in H_2 than in D_2 to form the same numbers of pairs of ions in each gas; this excess energy is constant down to 2000 eV and amounts to 250 eV for ionisation by H canal rays and 300 eV for D canal rays. From these observations and calculations it is concluded that in the ranges 2000 to 17500 eV for H canal rays and 2,200 to 8000 eV for D canal rays at the most 2×10^{-4} of the energy calculated from the collision laws can be transferred to the atom. It follows further that the energy balance for collisions in H_2 and D_2 can only be different for collisions below 2000 eV. Such a difference can only be due to a difference in mass of the colliding particles and is thus an impulse transference. From comparison of the ionisation by H and D canal rays it must be assumed that the collisions in which there is an impulsive transfer take place against the whole molecule. J. E. K.

4627. Formation of Negative Ions at Metal Surfaces. R. A. Smith. *Roy. Soc., Proc.* 168*A*. *pp.* 19–42, *Oct.* 10, 1938.—Various processes of formation of negative ions at metal surfaces, and the conditions under which they may take place are discussed. Detailed calculations are given for the conversion of Hg^+ ions into Hg^- ions at a Ni surface. The positive ions are assumed to be neutralised by capturing an electron from the metal, and to form excited atoms which subsequently capture another electron on falling into their ground state. This process is shown to account for the experimental results of Arnot and Milligan [see Abstract 4820 (1936)]. The calculated probability of formation by this process is $1 \cdot 4 \times 10^{-3}$ for 200 V Hg^+ ions striking a Ni surface normally. The process of simultaneous capture of two electrons from the metal is shown to be improbable. A negative ion formed near a metal surface for which the work function is greater than the electron affinity of the corresponding atom or molecule will have a considerable chance of being neutralised through one of its electrons passing into an unoccupied level in the metal. It follows that slow positive ions or metastable atoms will be ineffective as a source of negative ions. The formation of atomic negative ions from molecular positive ions is discussed. Calculations for the formation of H^- ions from H_2^+ ions and from protons are given. The value obtained for the probability of formation of H^- ions from 140 V protons striking a surface with work function less than 3·37 eV is about 4×10^{-3}. It is shown that H^- ions will not be formed from protons at a surface with work function greater than 3·37 eV unless simultaneous capture of two electrons takes place. For formation of H^- ions from H_2^+ the observed probability is only $1 \cdot 04 \times 10^{-5}$ for 200 V H_2^+ ions striking a Ni surface [see Abstract 836 (1937)]. This low value is shown to be due to the small probability of formation of the intermediate excited H atoms by dissociation of the incident ions. Clearly further experiments, using separated beams of protons and H_2^+ ions, are required in order to clarify the processes taking place when atomic negative ions are formed from molecular positive ions.
AUTHORS.

4628. New Process of Negative-Ion Formation. Part IV. F. L. Arnot and C. Beckett. *Roy. Soc., Proc.* 168*A*. *pp.* 103–122, *Oct.* 10, 1938.—In Parts I–III [see Abstract 836 (1937)] a new process of negative-ion formation was described. This process is the formation of negative ions at metal surfaces by bombardment of the surface with positive ions, the negative ion being formed by the positive ion capturing two electrons from the surface. The present paper shows that a new modification of this process can also occur. The experimental results show that a spectrum of negative ions is obtained when a surface is bombarded with positive ions of A or N or Hg, and that practically identical negative ion curves over the range of mass numbers from 10 to 54 are obtained by each type of positive ion. The negative ions observed have mass numbers 12, 16, 24, 29, 32, 38, 44 and 51. It is concluded that these negative ions arise from atoms and molecules of gas vapour adsorbed on the surface. It thus appears that there are two processes leading to the formation of negative ions at surfaces. The initial stage in each process is the same; this is capture of an electron from the surface by the incident positive ion into an excited state of the atom, probably by a resonance process. This excited atom, on reverting to its normal state, may then capture a second electron from the surface, again probably by a resonance process, so forming a negative ion of the same element as the incident positive ion.

The second process consists in the excited atom transferring by a collision of the second kind its excitation energy to an adsorbed atom on the surface, which then captures an electron from the surface, and so a negative ion of an element different from that of the incident positive ion is produced. The previous results are reviewed in the light of this new work which shows that no negative ions of N are formed. Certain alterations in the interpretation of the CO_2 results must also be made. The previous work on the formation of negative ions of Hg, H and O requires no amendment, except that the probabilities of formation of these ions may have to be raised. It is shown that no O_2^- ions are formed at the surface of an oxidised W filament, but that they readily appear when the filament is cleaned by flashing. It is suggested that this effect is due to the increased work function of the filament when oxidised. It is also found that a covering of O_2 on the filament suppresses the peaks of mass numbers 24 and 38. AUTHORS.

4629. Formation of Negative Ions by Positive-Ion Impact on Surfaces. R. H. Sloane and R. Press. *Roy. Soc., Proc.* 168*A*. *pp.* 284–301, *Oct.* 25, 1938.—It has been found that when a hot-kathode discharge is passed through Hg vapour, light negative ions are produced from surfaces exposed to positive-ion bombardment. The negative ions include some with energies greater than could be imparted to them in the existing electric fields. Experiments are described which eliminate the possibility that the excess energies could be produced through electrical oscillations. The conditions under which the negative ions appear indicate that they are produced mainly through sputtering of occluded electronegative films under the action of Hg positive-ion bombardment, but data from experiments of this type cannot be interpreted unambiguously. The existence of this process has been shown directly by a double mass spectrograph in which beams of positive ions of known kind are allowed to impinge normally on a metal disc in high vacuum and are found to produce a spectrum of negative ions, with properties similar to those of the negative ions obtained in previous experiments [*Nature*, 141. *p*. 872, *May* 14, 1938]. The existence of Hg^- as a stable entity seems to be still in doubt. AUTHORS.

4630. Dissociation of O_2 and Formation of O_3 in the Silent Electric Discharge. R. Krishnan and S. K. K. Jatkar. *Indian Inst. of Science, J.* 21*A*. 20. *pp*. 223–236, 1938.—The authors have investigated the reaction in the Siemens ozoniser under static conditions and the equilibrium has been studied from the standpoint of the application of the law of mass action. Equilibrium was attained from one side only, using different initial pressures and different exciting voltages. At higher pressures there was a gradual approach to equilibrium when the exciting voltage was low. At lower pressures, there was a rise in pressure apparently due to the dissociation of O_2 into O atoms. When the exciting potentials were increased the equilibrium was reached in a shorter time and the dissociation of O_2 was observed at a higher pressure of O_2 than in experiments at a low exciting voltage. The O_3 produced is never proportional to ionisation as the quantity of O_3 formed is not at all related to the current flowing. Instead of assuming that a large number of secondary ions are produced by shock excitation and that these ions do not reach the electrode even under saturating conditions, it is much simpler to assume that dissociation of O_2 occurs under the effect of silent electric discharge and that the atomic O combines with the excited O_2 molecule to form O_3. The equilibrium constant is calculated for the two reactions $O_2^* \rightleftharpoons 2O$ and $O_2^* + O \rightleftharpoons O_3$, which occur simultaneously. The constants are fairly concordant and well within the experimental error. AUTHORS.

See also Abstracts **4450, 4461, 4515, 4517, 4635,** and
3171B. Arc Discharge in Magnetic Field. S. Fukuda and S. Hoh.
3172B. A.C. Spark between Large Electrodes. Y. Ishiguro and V. Gosho.
3174B. Glow Voltage Curves for Noble Gases. H. Klemperer.

CONDUCTION IN SOLIDS AND LIQUIDS.

***4631. Push-Pull-Stabilised Triode Voltmeter. C. Williamson and J. Nagy.** *Rev. Sci. Instruments,* 9. *pp.* 270–272, *Sept.,* 1938.—This general purpose, balanced triode voltmeter is stabilised by adjusting shunt resistors until the effective values of μ and I_p are the same for both tubes. Built-in testing equipment is provided. The electrical zero of the galvanometer is unaffected by changes of ± 20% in power-supply voltage when the circuit has a d.c. sensitivity of 40,000 mm./V. The valves need not be specially selected. The balancing principle may be adapted for use in any circuit requiring matched valves. AUTHORS.

4632. Null Method for Measuring E.M.F. with a Ballistic Galvanometer and Condensers. A. W. Smith. *Am. Phys. Teacher,* 6. *pp.* 263–264, *Oct.,* 1938.—An unknown e.m.f. can be compared with the standard e.m.f. by using them to charge two condensers. The positive and negative charges in these condensers are allowed to mix, and the remainder is discharged through a ballistic galvanometer. This is a null method if one of the capacitances can be varied to give equal charges in the two condensers. A megohm, more or less, in series with the unknown e.m.f. does not decrease the accuracy of measurement. Several uncertainties are eliminated by using this as a substitution method. AUTHOR.

***4633. Characteristic Constants of the Moving-Coil Galvanometer and their Determination from the Periodic Proper Motion. L. Merz.** *Zeits. f. Instrumentenk.* 58. *pp.* 324–331, *Aug.,* 1938.—It is shown that the constants determining the performance of a moving-coil galvanometer can all be determined without difficulty with the exception of the effective turning couple. The latter quantity can be found by studying the oscillations of the moving system with different resistances in the external circuit. An error limit of 2% is obtainable. W. S. S.

***4634. Direct-Voltage Amplifier. E. L. E. Wheatcroft.** *Journ. Sci. Instruments,* 15. *pp.* 333–336, *Oct.,* 1938.—A mains-operated amplifier is described having an amplification ratio of about 600 and suitable for all frequencies from zero to 10,000 ∼. The full scale input is 100 mV and the input current is less than 10^{-9} A. The instrument employs standard receiving valves and is compensated to give a steady reading with normal variations of mains voltage. AUTHOR.

***4635. Dual-Range Potential Source for Field Use with Electroscopes and Geiger-Müller Counters. W. C. Bosch.** *Rev. Sci. Instruments,* 9. *pp.* 308–309, *Oct.,* 1938.—The battery-powered, portable potential source described utilises a hand-cranked condenser-type d.c. multiplier to keep an output condenser charged to a potential constant within 1%. A potentiometer and switching arrangement in the input circuit make available two output ranges of approximate values 0 to 0·43 kV and 0·65 to 1·08 kV. The unit is carefully insulated and operates efficiently under all conditions of humidity. AUTHOR.

4636. Streaming Potentials and Surface Conductivity. A. J. Rutgers, E. Verlende and M. Moorkens. *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 763–775, 1938. *In German.*—The abnormal form of the curves of ζ against c for KCl is considered to be due to the influence of surface conductivity. Equations are developed which require the determination of the true ζ-potentials, and the surface conductivity to be calculated from measurements on two capillaries, and from measurements on three capillaries to prove the correctness of the method of treatment. The apparatus used, the method of obtaining constant pressure, the measurement of electrical conductivity with the immersion electrodes, under exclusion of the atmosphere, are described. The results, obtained with capillaries made of Jena 16 glass, are given for KCl and $BaCl_2$. The theory is supported by the experimental results. F. J. B.

4637. Electronic Conduction due to 4*f*-Electrons in Trivalent Rare-Earth Compounds. K. Ghosh and B. Ghosh. *Indian Journ. Phys.* 12. *pp.* 259-270, *Aug.*, 1938.—The conductivity of fluorides of La, Ce, Pr, and Nd in the form of fine crystals has been measured by compressing them to the form of solid rings placed between two co-axial cylindrical electrodes. Taking lanthanum fluoride as standard and subtracting the conductivity of lanthanum fluoride from those of other fluorides, the contribution to conductivity due to 4*f*-electrons has been determined. Using a formula similar to that of Wilson for semiconductors, it is found that ΔW calculated from the measurements agrees approximately with the over-all width of the multiplet structure of the free ions of these elements as obtained from magnetic and spectroscopic data. AUTHORS.

4638. Atomic Resistance Increase of Dilute Lead Alloys between 273° and 14° K. A. Eucken and H. Schürenberg. *Ann. d. Physik,* 33. 1. *pp.* 1–20, *Aug.*, 1938.—The increase in resistance of Pb due to the addition of 1% (atomic) of Mg, Ag, Cd, In, Sn, Sb, Hg, Tl and Bi respectively is determined from observations of the resistance ratios, R_t/R_{273}, of various percentages of these dilute binary alloys at temperatures between 273° and 14° K. The alloys are found to obey Norbury's rule, and the atomic increase in resistance also appears to be approximately proportional to the logarithm of the diffusion coefficient of the foreign element into Pb divided by the self-diffusion coefficient of Pb. At the lower temperatures considerable departures from Matthiessen's law are noticed. The upper solubility limits of Cd, Sb and Mg in Pb at normal temperatures are shown to be 0·65, 0·13 and 0·5% (atomic) respectively. R. W. P.

4639. Electrical Conductivity and Phase Diagram of Ba Alloys with Bi, Mg, and Pb. G. Grube and A. Dietrich. *Zeits. f. Elektrochem.* 44. *pp.* 755–767, *Oct.*, 1938.—Previous work [see Abstract 3809 (1938)] is extended to the systems Ba-Bi, Ba-Mg and Ba-Pb. Thermal analysis indicates the existence of the compounds $BaBi_3$ and $BaMg_9$. Two further phases in the Ba-Mg system probably have the formulæ $BaMg_4$ and Ba_2Mg_5. An apparatus is described in which the electrical resistance of solid and liquid alloys can be measured at temperatures up to 1000° C. This is used to investigate the system Ba-Pb over the whole concentration range and the results are embodied in a complete phase diagram. The compounds $BaPb_3$ and Ba_2Pb melt without decomposition, while BaPb melts with decomposition and exists in two forms. The compound Ba_2Pb forms mixed crystals with the components over a limited range. Small additions of Ba to pure Pb cause marked increases of hardness during "ageing" at room-temperature. L. A. W.

4640. Conductivity Data of Aqueous Mixtures of H_2O_2 and HNO_3. W. H. Hatcher and D. W. MacLauchlan. *Canad. J. of Research*, 16. *Sect. B. pp.* 253–259, *Aug.*, 1938.—Solutions of H_2O_2 and HNO_3 are unstable when the concentration of the latter is greater than 50%. The conductivities of HNO_3 solutions of concentrations lower than this value in water and water-peroxide mixtures have been determined, and the results indicate the formation of one or more unstable peroxides or peracids apparently incapable of ionising. AUTHORS.

4641. H.F. Conductivity of Colloidal Electrolytes. G. Schmid and E. C. Larsen. *Zeits f. Elektrochem.* 44. *pp.* 651–658; *Disc.*, 658, *Sept.*, 1938.—Change over into the colloid state is characterised by a marked drop in conductivity, osmotic pressure, activity, etc. From the chemical standpoint of McBain and Lottermoser this is attributed to prevention of dissociation, by formation of neutral colloids; from the electrostatic standpoint of Hartley and Pauli, to the action of interionic forces as a result of the formation of highly charged colloid ion micelles. Conductivity measurements at $\lambda = 12$ and 20 m., on solutions of Na duodecylsulphonate, cetylpyridine chloride, Na oleate, K and Ca arabinates show a sharp increase of conductivity at high frequency. [See also Abstract 312 (1938).] The persistence of these substances as strong electrolytes right into the colloidal region must therefore be postulated, in opposition to classical chemical theory. D. R. H.

4642. Passage of Electrons through Thin Films of Insulators. H. Klarmann and J. Mühlenpfordt. *Zeits. f. Elektrochem.* 44. *pp.* 603–606; *Disc.*, 606, *Sept.*, 1938.—The conductivities of thin films of organic and inorganic insulators are studied in a direction at right angles to the surface. The former include phenolic resins, shellacs and varnishes in thicknesses of from 1 to 2 μ, and the latter comprise films of B_2O_3, CaF_2 and SiO_2, reproducible results being obtained for SiO_2 in thicknesses of 0·1 to 0·2 μ but not for the other two inorganic films. In each instance the films are formed on a plate of polished Ag, and this serves as one electrode. At times an evaporated film of Ag formed the other electrode, but tin-foil, Hg and $CuSO_4$ solutions are also used. The nature of this second electrode is found to affect the results obtained for the lacquers. These organic films have a resistance which increases with the applied voltage whereas the resistance of the SiO_2 film is much greater, and decreases as the voltage is increased. The conductivity of the SiO_2 is attributed to cold electronic emission, and the lacquer films are shown to contain holes through which metallic electrons pass. R. W. P.

4643. Electrical Conduction in Quartz, Periclase, and Corundum at Low Field Strength. E. G. Rochow. *J. of Applied Physics*, 9. *pp.* 664–669, *Oct.*, 1938.—A method has been devised for measuring the electrical conductivity of single crystals at elevated temperatures and at field strengths below 3 V/mm. The conductivities of single crystals of quartz, periclase, and corundum have been measured by this method over a temperature range of 600° to 1400° C., in equilibrium with air. The increase of conductivity with temperature follows a single exponential relation in all cases, throughout the temperature range covered. Experimental curves and interpolated values are given. AUTHOR.

***4644. Trends of Instrument Design. C. C. Mason.** *Journ. Sci. Instruments*, 15. *pp.* 323–333, *Oct.*, 1938.—The expansion in the use of electricity demands measuring instruments of greater accuracy and covering wider fields. Measurements of physical or chemical changes are often made by conversion of electrical variables capable of more convenient or accurate measurement, as for example in the measurement of temperature, pH, and gas percentage by the katharometer method. The application of Wheatstone bridge or potentiometer circuits to the measurement of varying extension or thickness of the order of 0·0001 in., and a recording densimeter are described and illustrated. The development of oscillographs and other electrical measuring instruments is traced with particular reference to some problems in design inherent in high-speed recording. The principles of micro-recording on celluloid by means of an accurately formed stylus are described with application to the measurement of vibration, acceleration, extension and pressure. [See also *Engineering*, 146. *pp*. 317–320, *Sept*. 9, 1938. *Paper read before the British Assoc. Cambridge*, Aug., 1938.] AUTHOR.

See also Abstracts 4288, 4369, 4549, 4733.

DIELECTRICS AND CAPACITANCE.

4645. Dipole Moments of Molecules Containing Two Movable Dipoles. J. Y. Beach and D. P. Stevenson. *J. Chem. Phys.* 6. *pp.* 635–638, *Oct.*, 1938.—The average dipole moment of a molecule containing two movable dipoles has been calculated as a function of temperature and restriction to internal rotation for three different potential functions. The potential functions used are: $(V_0/2)(\cos\phi+1)$, $(V_0/\pi)(\pi-\phi)$ and $V_0/\pi^2(\pi-\phi)^2$, where V_0 is the difference in potential energy between the *cis* and *trans* forms of the molecule and ϕ is the angle between the planes containing the dipoles and the axis of rotation. Values of the integral $\int_0^\pi \cos x \exp(-bx^2)dx$ are tabulated for values of b ranging from 0 to 2 at intervals of 0·1. The dipole moments of *s*-dichloro-ethane, 1,2-bromo-chloro-ethane and *s*-dibromo-ethane as a function of temperature are used with the three potential functions to determine values of V_0. The values thus obtained are compared with the values obtained by other methods. AUTHORS.

4646. Internal Rotation in Ethylene Chloride. J. Y. Beach and K. J. Palmer. *J. Chem. Phys.* 6. *pp.* 639–644, *Oct.*, 1938.—The electron diffraction method of investigation has been used to determine the nature of the potential barrier restricting the rotation about the C-C single bond in ethylene chloride (CH_2Cl-CH_2Cl). Assuming that the shape of the barrier is given by a cosine function, the height of the barrier is between 5 kg.cal./mole and infinity. This potential barrier is compared with the barrier resulting from the exchange repulsions and the electrostatic repulsions of the two ends of the molecule. Eyring's method was used for calculating the exchange repulsions. The repulsions between the Cl atoms must be calculated differently from the repulsions between H and Cl atoms in order to obtain agreement between theory and experiment. Experiments were duplicated at Princeton and Pasadena. AUTHORS.

4647. Dipole Moments of HCl and DCl. R. P. Bell and I. E. Coop. *Faraday Soc., Trans.* 34. *pp.* 1209–1214, *Oct.*, 1938.—Polarisation measurements over a range of 230° show that the dipole moment of DCl gas is definitely greater than that of HCl. The difference amounts to $0{\cdot}003 \times 10^{-18}$ or $0{\cdot}007 \times 10^{-18}$, according to the method of calculation. The value of μ found for HCl is $1{\cdot}08_4 \times 10^{-18}$. The difference found is consistent with the value calculated from the anharmonicity of the zero-point vibration and the "effective charge" derived from infra-red data.

From the sign of the observed difference it is concluded that the instantaneous dipole moment of HCl *decreases* with increasing internuclear distance in the neighbourhood of the equilibrium point. It is shown that the variation of the "effective charge" with internuclear distance is probably of minor importance in determining the isotope effect. AUTHORS.

4648. Dielectric Properties of Some Organic Substances. G. R. Paranjpe and D. J. Davar. *Indian Journ. Phys.* 12. *pp.* 283–288, *Aug.*, 1938.—The density, the refractive index and the dielectric constant are determined at room-temperature (30°C) for the solutions of oleic acid, linolic acid, triolein, triricinolein, and tristearin, in benzene. The dielectric constant is determined at 7,500 kc./sec. (40 m.) using the method of resonance and a valve-voltmeter. The refractive index is determined for Na lines. The polarisations and the electric moment of the substances are calculated from the Debye equation using the method of least squares. The electric moment is explained from the point of view of the chemical constitution and structure of the substances. The values obtained are: oleic acid 1·009, linolic acid 1·208; triolein 3·158, triricinolein 4·117 and tristearin 2·844. AUTHORS.

4649. Dielectric Properties of Acetylenic Compounds. Part X. F. J. Krieger and H. H. Wenzke. *Am. Chem. Soc., J.* 60. *pp.* 2115–2119, *Sept.*, 1938.—An apparatus has been constructed for measuring accurately the dielectric constants of gases and vapours at various pressures and temperatures. A method which obviates the necessity of equations of state is used in determining the polarisations of gases and vapours from their dielectric constants. The dielectric constants, polarisations and electric moments have been determined for gaseous methyl-, ethyl-, propyl-, butyl- and amyl-acetylenes. [For Part IX see Abstract 316 (1938).] AUTHORS.

4650. Electric Polarisations of Metallic Acetylacetonates. A. E. Finn, G. C. Hampson, and L. E. Sutton. *Chem. Soc., J. pp.* 1254–1263, *Sept.*, 1938.—Dipole measurements have been made on Be acetylacetonate in a variety of solvents, and between 298–415° K. in decalin, and on several metallic acetylacetonates in C_6H_6 solution. The data obtained in non-polar solvents show a large difference (approximately 45% ${}_EP_2$) between the mol. total polarisation P_2 and the mol. electron polarisation ${}_EP_2$ of the solute, which has second order dependence on the solvent, and which falls into one of three groups of rough ratio 2 : 3 : 4 as the compound contains 2, 3 or 4 chelate groups. The results may be due to (i) a transitory electric moment arising from slow bending within the molecule caused by thermal bombardment [see Hampson, Abstract 4318 (1934)], or (ii) to atom polarisation, in which the field induces considerable moments by causing inter-nuclear movements. The former is not probable, as calculations show that the frequency of bending would be too high for the molecule to orient while bent. [See following Abstract.] W. R. A.

4651. Electric Moments of *p*-Benzoquinone and Related Compounds. D. L. Hammick, G. C. Hampson and G. I. Jenkins. *Chem. Soc., J. pp.* 1263–1268, *Sept.*, 1938.—*p*-benzoquinone, its symmetrical dimethyl- and dichloro- derivatives, and 2 : 2 : 4 : 4-tetramethyl*cyclo*butane-1 : 3-dione, with geometrically symmetrical molecules whose electric moments should be zero, are definitely polar, with an approximately constant difference between their total and electron polarisations. A mechanical model of the structure of *p*-benzoquinone shows that polarisation by bending is possible, but cannot be the primary cause. This is confirmed by calculation of the frequency of bending which does not agree with the infra-red absorption frequency. The polarisation discrepancies are therefore high atom polarisations or solvent effects. [See preceding and following Abstracts.] W. R. A.

4652. Electric Polarisations of Substances having Anomalous Dipole Moments, and their Bearing on the Theory of Atom Polarisation. I. E. Coop and L. E. Sutton. *Chem. Soc., J. pp.* 1269–1286, *Sept.*, 1938.—The electric polarisations of various acetylacetonates, symmetrical diketones, symmetrical diNO_2- and diCN- compounds, and tetrahalides in the vapour state have been measured over various ranges of temperature. The polarisations are temperature independent; and comparison with results obtained in solution (*loc. cit.*) show that the anomalous moments are not due to solvent effects. The compounds studied are non-polar in their unperturbed configurations, and can only become polar as a result of bending or twisting. The observed facts are therefore due either to slow thermal bendings (I) or to atom polarisation P_A. Calculation of the vibration frequencies, however, eliminates (I). Extending the theory of P_A, a relation is obtained between P_A, force constant of bending, and bond moment for a molecule, which has been tested quantitatively with success for a number of compounds; the series of diphenyl Hg compounds proves an exception. The polarisations of the diketones studied are explained by the hypothesis that each $C{=}O$ bond bends relatively to the rest of the molecule and perpendicularly to the plane of the double bond. [See preceding Abstract.] W. R. A.

4653. Dipole Moments of Aliphatic and Aromatic Aldehydes and of Anthrone. D. I. Coomber and J. R. Partington. *Chem. Soc., J. pp.* 1444–1452, *Sept.*, 1938.—The dipole moments of a number of aldehydes have been measured. The moments of the lower aliphatic aldehydes are discussed from the point of view of the series effect. From the moments of benzaldehyde and its substituted derivatives an angle of 55° between the axis of the ring and the $C{=}O$ direction is found. Allowance for interaction moment in the *p*-substituted compounds is made by a comparison with the corresponding acid chlorides, and by an application of these results a value of 125° is found for the angle between the axes of the rings in benzophenone. The —CHO groups in *p*-phthalaldehyde are found to exhibit completely free rotation. AUTHORS.

4654. Frictional Dispersion of Dielectric Constants of Organic Liquids. E. Plötze. *Ann. d. Physik*, 33. 3. *pp.* 226–242, *Oct.*, 1938.—Very full experimental details are given for measuring the frictional dispersion to a great degree of accuracy of the dielectric constants of organic liquids in dilute solutions. A contribution is also made to the problem of the quantitative evaluation of the respective dispersion curves, *e.g.* determination of such characteristic magnitudes as relaxation-times, molecular frictional coefficients, molecular diameters, and rotational hindering of polar molecules. The liquids were: Pure paraffin- and shell oils, nitrobenzene in paraffin and shell oils, amyl alcohol in shell oil, nitrobenzene in hydrorubber, chlorobenzene in hydrorubber, nitronaphthalene in shell oil. 14 sets of dispersion curves are included. H. H. Ho.

4655. Dielectric Constant of Cellulose. H. A. De Luca, W. B. Campbell and O. Maass. *Canad. J. of Research*, 16. *Sect. B. pp.* 273–288, *Aug.*, 1938.—A method has been devised for the measurement of the dielectric constant of a material that cannot be made completely to fill a condenser. The following is the procedure adopted : Two completely miscible liquids are so chosen that the dielectric constant of the material under examination lies between the two values for the liquids. The dielectric constants of solutions of A and B ranging from 100% A to 100% B are measured. A curve is drawn showing the relation between dielectric constant and percentage composition. The condenser used is then partly filled with the fibrous material. The solutions of A and B are introduced into the condenser and the net dielectric constants are determined. A second curve is drawn showing this relation. The point of intersection of the two curves gives the composition of that liquid that has the same dielectric constant as the fibrous material. This method has been applied to the measurement of the dielectric constant of cellulose, benzene and ethylene dichloride being used. A value of 6·1 has been obtained for this constant. AUTHORS.

4656. Electrical Breakdown of Alkali Halides. R. J. Seeger and E. Teller. *Phys. Rev.* 54. *pp.* 515–519, *Oct.* 1, 1938.—A theoretical justification is given for the mechanism proposed by v. Hippel [see Abstract 729B (1938)] to account for the electrical breakdown of the alkali halides. Values of the breakdown field calculated on the basis of the theory are found to compare favourably with those obtained experimentally. A critical comparison is made with another explanation of the breakdown proposed by Fröhlich. [See Abstract 2785 (1937).] AUTHORS.

4657. Dielectric Loss in Polar Materials. F. H. Müller. *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 164–228, 1938.—The Debye theory of dipole moments and its application to dielectric materials containing polar molecules are first dealt with in detail. An account follows of the various experimental methods for the measurement of dielectric loss. Finally recent experimental data on the dielectric properties of polar materials are reviewed, and a comparison is made between the observed dielectric behaviour of the materials and the behaviour as predicted by the Debye theory. E. R.

See also Abstracts 4307, 4330, 4351, 4620, and

3333B. Attenuation Coefficients in Dielectric Cables. A. G. Clavier and V. Altovsky.

ELECTROCHEMISTRY.

4658. Galvanic Cells with Formation of Alloys. V. A. Plotnikov and D. P. Zosimovich. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 31–34, 1938. *In English.*—The authors report results obtained by short circuiting various cells, alloys being formed in this way by deposition of a base metal on a nobler one. In the cell Zn/ZnSO$_4$,aq/Cu, Zn potential remained at $-0{\cdot}79$ V while the Cu potential altered from $+0{\cdot}22$V to $-0{\cdot}70$, approaching that of Zn, at 18°C. The cell Zn/ZnCl$_{2\,\text{fused}}$/Cu at 380° ± 5°c. gave yellow α or β alloys after 40 min. and grey γ or ξ alloys after 180min. on the surface of the Cu, the latter alloy having a thickness of 0·012 mm. Breaks in the e.m.f./time plot are conjectured to be due to different phases, and X-ray analysis shows a triplex structure, with lines of α, β and γ, in some cases. In the cell Al/AlCl$_{3\,\text{fused}}$-NaCl$_{\text{fused}}$/Cu, α Al-Cu alloys are similarly formed, recrystallisation of α occurring at 300°-350°c., with rising temperature and increasing proportion of γ is formed. D. R. H.

***4659. Preparation of NaOH and H$_2$SO$_4$ by Electrolysis of Na$_2$SO$_4$. G. Grube and S. Stainoff.** *Zeits. f. Elektrochem.* 44. *pp.* 640–648, *Sept.*, 1938.—Electrolytic cells for the preparation of both NaOH and H_2SO_4 by the electrolysis of Na_2SO_4 solution are described, including cells with horizontal diaphragms, cells with vertical filter diaphragms, and the mercury process. The efficiency of the various processes is discussed. A. J. M.

4660. Calculation of the Ionisation Constants of Inorganic Oxygen Acids from their Structures. A. Kossiakoff and D. Harker. *Am. Chem. Soc., J.* 60, *pp.* 2047–2055, *Sept.*, 1938.—The calculation of the ionisation constants of inorganic oxygen acids has been carried out on the basis of reasonable assumptions concerning the structures of the acid molecules and the mechanism of ionisation. Most of the calculated ionisation constants agree with the experimental ones to within a factor of 8. The free energy of ionisation has been shown to consist of a term depending only on the structure of the acid and a term depending only on the solvent and the temperature. The constant term has been evaluated from the ionisation constant of a single acid of known structure. The ionisation constants of a large number of acids have been evaluated, and have been found to agree well with experimental values. On the basis of the calculation the structures of a number of acids have been determined from their known strengths. The effect of resonance on the strength of acids is discussed. AUTHORS.

4661. Observation of Diffusion Layer in Electrodeposition. H. J. Antweiler. *Zeits. f. Elektrochem.* 44. *pp.* 719–724, *Oct.*, 1938.—Two experimental arrangements are described by which it is possible to render visible the diffusion layer at a Hg drop electrode during electrolysis. Both methods make use of the differences of refractive index which occur. The first method (the *schlieren* method of Toepler) is only applicable to solutions of concentration greater than $0{\cdot}1N$. The second method, in which an arrangement similar to a Jamin interferometer is used, can be applied for concentrations down to $0{\cdot}002N$. Both arrangements are so luminous that photographic exposures of 1/300 sec. can be made. Photographs are reproduced. L. A. W.

4662. Coupling of Ionic Transference in the Case of Multiple Electrodes. K. Nagel. *Zeits. f. Elektrochem.* 44. *pp.* 637–639, *Sept.*, 1938.—A graphical method of investigating the possible ionic transferences between two ionic phases is described. A. J. M.

4663. Electrolytic Migration Velocity in Metallic Solutions. K. Schwarz. *Zeits. f. Elektrochem.* 44. *pp.* 648–650; *Disc.*, 651, *Sept.*, 1938.—Apparatus is described for the determination of the velocity of ions in metallic solutions (dilute amalgams). The ionic velocity is of the same order of magnitude as in aqueous solutions, amounting to several cm./hr. for a potential gradient of 1 V/cm. A. J. M.

4664. Elimination of Liquid-Junction Potentials. Part I. B. B. Owen. Part II. B. B. Owen and S. R. Brinkley, Jr. *Am. Chem. Soc., J.* 60. *pp.* 2229–2239, *Sept.*, 1938.—A method of eliminating heterionic liquid-junction potentials was tested in cells with buffer solutions, and extrapolation from the numerical results so obtained. The junction extrapolation was found to be linear as a first approximation. The method was applied to the determination of the standard potential of the Ag electrode at 5,° 15,° 25,° 35°, and 45° C. By combination of the normal potentials of the Ag and Ag-Ag-halide electrodes, the solubility products and the solubilities of (electrolytic) AgCl, AgBr and AgI were computed from 5° to 45°C. F. J. B.

***4665. Reactions with Commutated D.C. at a Graphite Electrode. V. Sihvonen.** *Zeits. f. Elektrochem.* 44. *pp.* 659–662, *Sept.*, 1938.—A new three piece *H*-cell is described, and yields of H_2, O_2, CO_2, CO, CH_2O, $CH_2(OCH_3)_2$ under different conditions, with H_2SO_4, Na_2SO_4, and NaOH as electrolytes, are reported. O_2 appears to be more active than H_2. As a result of H_2O formation oxidation of the graphite is slower in NaOH. Formaldehyde synthesis appears to depend on alternate oxidising and reducing conditions at the graphite surface as well as on porosity, and is almost absent in concentrated H_2SO_4. The various organic reactions necessary for production of an α diketone group are discussed. With too rapid commutation in acid electrolytes, there is practically quantitative production of H_2O. D. R. H.

***4666. New Polarograph and Applications. A. Schmidt.** *Zeits. f. Elektrochem.* 44. *pp.* 699–708, *Sept.*, 1938.—A description is given of an instrument which is an elaboration of the so-called polarograph of Heyrovsky and Shikata. Not only is an automatic photographic record of the current obtained, but the polarisation of the electrode under investigation is simultaneously recorded on the same paper. This is achieved by connecting the electrode to a normal electrode by means of a Luggin capillary and recording the e.m.f. of the resulting element by means of an amplifier and mirror galvanometer. A reversing device enables the polarographic records to be obtained both in rising and falling directions and the range can be extended past the zero point into the region of opposite sign. A device is also incorporated whereby measurements can be carried out at different velocities. In the second part of the paper an account is given of the application of the instrument to investigations of H_2- and metal electrodes. L. A. W.

4667. Potential of Pt in Solutions of Ag Salts. A. Obrutschewa. *Acta Physicochimica*, 8. 6. *pp.* 679–696, 1938. *In German.*—The variation of the potential of a Pt or Au electrode in solutions of Ag salts with time has been determined. The fall in the potential is shown to be due to the presence of small concentrations of Ag_2 ions in the solution. These first reduce the O_2 adsorbed on the metal, and finally deposit Ag on the electrode. The adsorption of Ag salts on platinised Pt was investigated and it was shown that this process is not responsible for the characteristic potential jump of the Ag electrode. The potential of Ag in $Cu(NO_3)_2$ solutions observed by Essin and Beklenyschewa can be quantitatively explained by the assumption that the reaction $Ag+Cu^{\cdot\cdot}\rightarrow Ag^{\cdot}+Cu^{\cdot}$ occurs.
A. J. M.

See also Abstracts 4296, 4363, 4636, 4644.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

4668. Multiple Structure of the Electron. U. Kakinuma. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 818. *pp.* 991–1000, *Sept.*, 1938. *In English.*—A stationary electron has a multiple structure of spherical symmetry. The innermost core of radius $\sqrt{\kappa e}$, or $\sqrt{\gamma e}/C^2$ $(=10^{-30}$ cm.) contains the electronic mass and charge. The outer region extending from $e^2/2mc^2$ to infinity is the ordinary electromagnetic field in which the energy mc^2 is stored. The intermediate region has not yet been explored. The quantum mechanics deals with the state of these fields superposed altogether. The energy in the core is composed of two parts: the one is of the fixed value corresponding to the spin magnetic energy, and the other is of a variable amount sharing the kinetic energy with which the electron describes a certain Bohr orbit. The spin angular momentum is identified with the intrinsic action of the electron, *viz.*, $h/2$. The corresponding magnetic moment is calculated classically, obtaining the correct value—$he/2mc$. AUTHOR.

4669. Mass of the Neutron. G. Stetter and W. Jentschke. *Zeits. f. Physik*, 110. 3–4. *pp.* 214–222, 1938.—By means of an ionisation chamber and a proportional amplifier the yield of protons, liberated from D by irradiation with the hard γ-radiation of ThC'' of 2·623 eMV energy, was measured as 6650 ± 200 El.Qu. The mean energy necessary for the production of ions in H by quite short H-rays has been accurately determined as $32 \cdot 6 \pm 1 \cdot 2$ eV. From this the binding energy of the deuteron is calculated to be $2 \cdot 189 \pm 0 \cdot 022$ eMV, and the mass of the neutron as $1 \cdot 00895 \pm 0 \cdot 00003$, using the present best mass-spectroscopic value. G. O. B.

4670. Velocity Distribution of Elastically Colliding Electrons. R. Lichtenstein. *Phys. Zeits.* 39. *pp.* 646–656, *Sept.* 15, 1938.—In a gas whose molecules have temperature motions there are electrons which make elastic impacts on the gas molecules. The velocity distribution of such electrons is calculated when they are subject to a homogeneous electric field. The electron density is assumed to be so small that the mutual effect of the charge carriers on one another can be neglected. From the electron balance in the velocity space simple expressions are derived for the distribution density, almost sphere-symmetrical, of the electrons in the velocity space. The data employed concerning the gas molecules are their mass and their so-called kinetic cross-section. The velocity distribution of the swift electrons is determined principally by the temperature motion of the gas molecules, which increases considerably the proportion of electrons rich in energy as compared with the case treated by Morse, Allis and Lamar, where the gas temperature was null [see Abstract 4383 (1935)]. A. W.

4671. Scattering and Loss of Energy of Fast Electrons and Positrons in Lead. W. A. Fowler and J. Oppenheimer. *Phys. Rev.* 54. *pp.* 320–324, *Sept.* 1, 1938.—A cloud-chamber investigation is made of the scattering and loss of energy in a thin lead lamina of fast electrons and positrons (5-17eMV) produced as secondaries by γ-radiation from $Li^7 + H^1$. Comparison of the experimental results of scattering with angle shows good agreement with the Rutherford-Mott theory at about $\theta = 13°$. Below this angle the behaviour is consistent with multiple scattering. Evidence is found for an excess scattering at large angles of electrons over positrons. The average loss of energy is found to be about 1·5 times the theoretical value. It does not seem possible to account completely for this excessive energy loss on the basis of a longer effective path in the lamina. No difference in the loss of energy of electrons and positrons is found. C. J. B. C.

4672. Inelastic Scattering of Slow Electrons from a Silver Single Crystal. J. C. Turnbull and H. E. Farnsworth. *Phys. Rev.* 54. *pp.* 509–514, *Oct.* 1, 1938.—The energy distribution of electrons inelastically scattered from a (111) face of an Ag single crystal has been studied by the method of magnetic deflection. At about 45° incidence primary electrons are regularly reflected in to the analyser, and diffraction beams are observed at primary energies of 7·7, 23·2, and 83·2 eV. The structure in the energy distribution shows two discrete loss peaks at

3·9 and 7·3 eV, respectively, in general agreement with that found by Rudberg for polycrystalline Ag. However, the relative intensities of the two discrete loss peaks depend on both the primary voltage and the target angle near the diffraction beams, while Rudberg has found that for polycrystalline targets the peaks are independent of these variables. The energy distribution curves are also distorted by an extra inelastic scattering which accompanies the elastic scattering of the diffraction beams, and which extends down to an energy loss of 10 to 15 eV. Thus, maxima are observed in the curves giving the amount of inelastic scattering as a function of the primary energy for the constant values of energy loss. The maxima occur at secondary energies equal to the critical voltages of the diffraction beams. This indicates the existence of a double process consisting of inelastic scattering of the incident electrons followed by diffraction of the scattered electrons by the crystal lattice. AUTHORS.

4673. Scattering of Fast β-Particles by Mercury Nuclei. A. Barber and F. C. Champion. *Roy. Soc., Proc.* 168*A*. *pp*. 159–167, *Oct.* 25, 1938.—The scattering of β-particles of about 1mV energy by Hg nuclei is examined with an expansion chamber for angles of scattering greater than 20°. The absolute number scattered is much less than would be expected from Mott's formula. There is also indication of more inelastic collisions than are predicted by the theory of Bethe and Heitler. Photographs are reproduced which show the sudden stoppage of a fast β-particle with the simultaneous production of what appear to be low energy pairs of positrons and electrons. It is suggested that the results may be qualitatively explained on the assumption of a repulsive field between electrons and nuclei for close distances of approach. AUTHORS.

4674. Rutherford Scattering with Radiation. W. Braunbek and E. Weinmann. *Zeits. f. Physik,* 110. 5–6. *pp*. 360–372, 1938.—A comparison of different formulæ obtained by Mott, Sommerfeld, Scherzer, Bethe and Heitler for the cross-section in nuclear scattering with radiation, which agree one with another, and the formula recently obtained by Bloch and Nordsieck [see Abstract 4026 (1937)] by a different method of approximation, shows that the earlier formulæ follow from the results of Bloch and Nordsieck when developed in a power series of α, the Sommerfeld fine-structure constant, the linear term being omitted. It is thus quite clear why, in spite of this close connection between the results, the method of Bloch and Nordsieck avoids the so-called infra-red catastrophe, which was involved in the earlier formulæ. The avoidance of the infra-red difficulty permits calculation to be made of the correction which Rutherford's angular distribution requires when radiation is taken account of, though in this method there is some unavoidable uncertainty as to the upper limit of the frequency spectrum. The relative correction to the Rutherford formula taking radiation into account is found to be of the order of magnitude of $\alpha\beta^2$ and is therefore extraordinarily small. [See also Abstract 3400 (1932).] A. W.

4675. Scattering of D-D Neutrons. S. Kikuchi and H. Aoki. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 808. *pp*. 865–872, *Aug.*, 1938. *In English*.—Investigations are described for the determination of collision cross-section measurements for 21 elements using monochromatic D-D neutrons of 2·4 eMV energy. Results are tabulated and plotted and are compared with those of other investigators. There is evidence that the cross-section is a regular function of the atomic number and has a maximum and minimum. This cannot be settled until a larger number of elements is studied. N. M. B.

4676. Neutron Resonance Levels of Ir and Rh. R. Jaeckel. *Zeits. f. Physik*, 110. 5–6. *pp.* 330–333, 1938.—Continuing previous work [see Abstract 862 (1938)], it is shown from absorption experiments in Rh that the two activities with half-periods 19·5 hr. and 68 days, produced when Ir is bombarded with slow neutrons, cannot arise from one and the same resonance level. F. C. C.

***4677. Fast Neutrons. H. Reddemann.** *Zeits. f. Physik*, 110. 5–6. *pp.* 373–388, 1938.—A discharge tube is described which is suitable for the production of very fast corpuscular rays. With it an investigation has been carried out into the yield of neutrons on bombardment of D with D. The cross-section for the D-D reaction has also been obtained in the range 0·1 to 1·0 MV. G. O. B.

4678. Action of Thermal Neutrons on Aluminium. P. Wang. *Zeits. f. Physik*, 110. 7–8. *pp.* 502–511, 1938.—Al is bombarded by neutrons which have been slowed down in paraffin, and by absorption experiments with Cd adsorbers it is shown that the activity with a 2·3-min. period, which is due to neutron capture, is produced by thermal neutrons. Absorption measurements in Al give for the absorption coefficient the value 0·037 cm^2./gm., which is rather low and therefore suggests that there is no resonance level in the thermal region. Experiments are also made with an arrangement in which the specimen is surrounded by paraffin on all sides. A discussion is given of the more complicated geometrical factors arising in this case. R. P.

4679. Equations of Motion of a Charged Particle in an Electromagnetic Field. T. Boggio. *Comptes Rendus*, 207. *pp.* 134–136, *July* 11, 1938.—A charged particle moves in the field of n magnetic poles situated on a straight line l and an arbitrary electric field which is always coplanar with l. A first integral of the equations of motion is found. R. P.

4680. Field Distribution and Graphical Ray Tracing in Electron Optical Systems. L. Jacob. *Phil. Mag.* 26. *pp.* 570–601, *Oct.*, 1938.—The electrolytic trough method is applied to the case of an electron-optical lens system for mapping out its field distribution to an accuracy of 2–3%. The approximate electron trajectory for an electron entering the field in a direction parallel to the axis is calculated, using the axial potential distribution and its derivatives. Errors as large as 50% are introduced in this step-by-step process of approximation which restricts its usefulness. Use is made of the axial "geometric plot" to derive a simple method for the graphical construction of the ray-paths which gives a good approximation. The cases of widely spaced as well as closely spaced surfaces are separately considered. [See following Abstract.] AUTHOR.

4681. Axial Potential Distribution in Electron-Optical Systems. L. Jacob. *Phil. Mag.* 26. *pp.* 601–609, *Oct.*, 1938.—The calculation of the positions of the cardinal points of a lens system consisting of coaxial cylindrical electron lens components is briefly summarised. It is then shown that, in kathode-ray tubes, where the electron lens involves a more complicated form of field function, it is necessary to obtain an accurate field plot from which the first and higher derivatives are obtainable. A method, based on the use of Legendre polynomials, is devised for obtaining accurately the equation to the axial equipotential plot in terms of the distance along the axis from a fixed origin. An example is worked out to an accuracy within 1% although the method is capable of yielding higher accuracy if desired. [See preceding Abstract.] H. J. H. S.

4682. Focal Length and Image Quality of Circular Hole Lens with a Central Net. M. Knoll and H. Weichardt. *Zeits. f. Physik,* 110. 3–4. *pp.* 233–236, 1938.—An accurate expression for the focal length of an electron lens consisting of two diaphragms with central apertures with a net placed midway between them is derived from the known approximate formula. The relative focal length for various dispositions of lens potential and dimensions is calculated and the results are expressed graphically. Some of the relations are verified experimentally.
H. J. H. S.

4683. Focusing Properties of Electrostatic Field between Two Cylinders. F. H. Nicoll. *Phys. Soc., Proc.* 50. *pp.* 888–898, *Nov.* 1, 1938.—A general survey of the focusing properties of an electron mirror formed by two cylinders has been made. Photographs of the images formed are shown, and the relations between object and image distances for different voltage ratios on the cylinders are obtained. A special case of multiple reflections is described. Some qualitative results relating to the behaviour of the two-cylinder lens at very high voltage ratios are given, and the formation of intermediate images in both lenses and mirrors is discussed. Finally, a qualitative description of the focusing properties of two cylinders for voltage ratios from $-\infty$ to $+\infty$ is given.
AUTHOR.

See also Abstracts **4270**, **4331**, **4376**, **4472**, **4519**, **4642**, **4644**, **4731**, and
3198B. Inversion Spectrum of a Kathode-Ray Tube. H. E. Hollmann.
3200B. Oscillograph with After Acceleration. A. Bigalke.

ELECTROSTATICS.

4684. Contact Potential. B. Gysae and S. Wagener. *Zeits. f. Physik,* 110. 3–4. *pp.* 145–163, 1938.—For demarcation of the p.d.'s brought into being on the contact of two bodies, one of which is the contact potential, there is given an accurate definition for each of the actual touchings concerned and a clear indication of its nature is provided. The separate potentials referred to are: the galvanic potential, the contact potential, the discharge potential and the volta potential. For contact potential the relative defining equation is especially dealt with, and it is shown that the quantum theory deduction is the most general. For experimental illustration of the existence of the contact potential a tube is used by which, with a W wire as kathode the space discharge characteristic line, both towards a second W wire and towards a Ta wire as anode, can be measured. J. J. S.

***4685. Projection Electroscope for α and β-Rays. B. A. Spicer.** *Journ. Sci. Instruments,* 15. *pp.* 336–338, *Oct.,* 1938.—An instrument is described for the demonstration of some effects of α- and β-rays. It is an electroscope in which the image of a gold-leaf is projected on to a screen for measurement or demonstration. AUTHOR.

***4686. Self-Exciting Electrostatic Generator with Charging Bands Situated in Compressed Gas. U. Neubert.** *Zeits. f. Physik,* 110. 5–6. *pp.* 334–351, 1938.—A description is given of the construction and operation of a self-exciting electrostatic generator with the charging bands situated in compressed gas. The supporting column is about 3 m. high and the charged sphere about 1 m. in dia. Of the different gases examined, compressed air was found to be the most generally satisfactory.

The potential obtained was determined with a simple resistance method based on Ohm's law and was found to be $7 \cdot 5 \times 10^5$ V in air and $9 \cdot 5 \times 10^5$ V in CCl_4 vapour. F. C. C.

See also Abstract **4635**.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4687. Thermomagnetic Longitudinal and Transversal Effect in Nickel. P. Wagner. *Ann. d. Physik,* **32.** 8. *pp.* 665–682, *Aug.,* 1938.—On the longitudinal and transversal magnetisation of a ferromagnetic wire, of which one part is above and the other below the Curie temperature, there occurs an e.m.f. The saturation value found for this e.m.f. by Broili [see Abstract **4598** (1932)] holds in all cases: $E_\infty = C(\Theta - T^2)$. The constant C depends in a high degree on the purity of the wire. The transversal e.m.f. and the longitudinal have opposite signs. Through lengthways extension the longitudinal e.m.f. may be increased to twice its value; the transversal e.m.f. may become 0. For an isotropic wire $C = -C_\perp$. It has not been explained why (analogously to the magnetic change of resistance) C_1 is not twice as great as $C_\perp$. The e.m.f. shows hysteresis with very small remanence; with increasing stress the hysteresis disappears. In strong fields there occurs a decrease of the e.m.f. both longitudinal and transversal. In consequence the time magnetisation can be certainly ascertained. With small differences of temperature and stretched wire the e.m.f. is proportional to the square of the magnetisation: $E = \alpha(T)J^2$. The constant $\alpha(T)$ may be reduced to the constant C_∞ (with great longitudinal stress). The following relation is strictly fulfilled: $\frac{\Delta E}{\Delta T} = \frac{2C_\infty J^2(T)}{J_\infty^2(T)}(\Theta - T)$. J. J. S.

MAGNETISM AND ELECTROMAGNETISM.

4688. Symmetries of the Magnetic Field. E. Brylinski. *Comptes Rendus,* **207.** *pp.* 136–138, *July* 11, 1938. **A. Cotton,** *ibid. pp.* 270–271, *July* 25, 1938.—The question whether a uniform magnetic field has mirror symmetry with respect to a plane at right angles to its axis or with respect to one through its axis depends on whether the field is described in terms of polar or axial vectors. R. P.

4689. Electricity as a Fluid. G. D. Birkhoff. *Frank. Inst., J.* **226.** *pp.* 315–325, *Sept.,* 1938.—An outline is discussed of a two-fluid theory in some respects resembling Franklin's one-fluid theory, but allowing the free interpenetration of positive and negative electricity to produce a true neutral condition; gravitational effects may be omitted from consideration. A brief historical review is given of the progress of theory since Franklin's time, and it is suggested that a new conceptual outlook on theoretical physics may be based on a fuller exploitation of relativistic electrodynamics. The views discussed are built up in consonance with certain purely mathematical necessities on the one hand and qualitative physical considerations on the other. On various assumptions a mathematical specification of the constitutive equations for the electrified fluid in space-time is derived. N. M. B.

4690. Magnetic Properties of Ni and Ni-Rich Alloys. T. Hirone. *Tohoku Univ., Sci. Reports,* **27.** *pp.* 101–114, *July,* 1938. *In English.*—Theoretical considerations on the line of the Bloch theory of ferromagnetism as well as the Slater theory of the electronic energy levels in metallic lattices are made on the change of magnetic properties of Ni due to the addition of foreign metals making Ni-rich binary solid solutions. The present theory explains fairly well the manifold experimental results upon the magnetic characteristics of various kinds of the said binary solid solutions. AUTHOR.

4691. Drift of Magnetic Permeability at Low Inductions after Demagnetisation. G. R. Patterson. *J. of Applied Physics,* 9. *pp.* 646–653, *Oct.*, 1938.—Attempts at measurement of the magnetic properties of ferromagnetic materials at very low flux densities showed inconsistencies which were attributed either to errors in methods or to some behaviour of the material. Check tests, using the same procedure in each case, eliminated the first supposition. The results of this investigation show that, with a steel of medium Si content tested at 10 gauss over a period of 24 hr., there exists a 5 to 15% decrease in permeability. On the average, 50 to 60% of this drift occurred within 1 hr. after demagnetisation and none after 24 hr. AUTHOR.

4692. Theory of Magnetic Neutral Solutions. New Possibility of Determining Magneton Values. O. v. Auwers. *Zeits. f. Physik,* 110. 3–4. *pp.* 267–270, 1938.—Data obtained from the determination of magneton numbers of the ions of the transitional elements, using water as solvent, confirm the data of Salceanu [see Abstract 2175 (1938)], and indicate that it is possible by the method of magnetic neutral solutions to determine magneton numbers. W. R. A.

4693. Magnetic Anisotropy and Pleochroism of Biotite Mica. P. Nilakantan. *Indian Acad. Sci., Proc.* 8*A*. *pp.* 39–60, *July,* 1938.—The paramagnetic anisotropy and susceptibility of three biotites, one muscovite and one phlogopite were determined, also their ferrous and ferric contents and their pleochroism. The biotites are highly anisotropic, and the anisotropy and pleochroism increase with the iron content. The anisotropy depends on the ferrous iron only. The results are in agreement with the theory of the paramagnetism of solids developed by van Vleck and others, based on the splitting of the energy levels of the paramagnetic ion under the influence of the strong asymmetric crystalline electric fields. The pleochroism of biotite is discussed in the light of Saha's view that absorption of light in inorganic salts of elements of the transition series is due to transitions involving the reversal of the spin vector of one of the 3*d* electrons of the kation. G. E. A.

4694. Transition Point of Magnetic Susceptibility of MnO. H. Bizette, C. F. Squire and B. Tsaï. *Comptes Rendus,* 207. *pp.* 449–450, *Aug.* 29, 1938.—In similar fashion [see Abstract 3022 (1938)] the susceptibility of MnO was determined down to 10° K. Between 273° and 127° (T_λ) results agree with those of Tyler [see Abstract 5455 (1933)], but below that χ diminishes with temperature. Above T_λ it is independent of strength of field, but increases therewith below that temperature. C. A. S.

4695. Magnetic Properties of Anhydrous Nickel Chloride and the Laws of Variation of Paramagnetism. P. Laurent. *J. de Physique et le Radium,* 9. *pp.* 331–336, *Aug.*, 1938.—The magnetisation of sublimed anhydrous $NiCl_2$ has been accurately determined between 15° and 450°. The coefficient of magnetisation, plotted as a function of the temperature, can show one of two forms depending on the previous thermal treatment of the sample. It may consist of two straight lines, a high temperature line characterised by a moment of 17·2 magnetons and a low temperature line of 16·4 magnetons, meeting near 250°; or the straight line at low temperatures may continue as a curve above 250°. The curved region, which corresponds to a metastable state of $NiCl_2$, is attributed to the existence of several moments. W. R. A.

4696. Magnetism and Molecular Constitution of Chromium Compounds. S. S. Bhatnagar, B. Prakash, and A. Hamid. *Chem. Soc., J. pp.* 1428–1434, *Sept.*, 1938.—In the present work an attempt is made to define the structure of some Cr compounds from the magnetic standpoint. The susceptibilities of Cr ions in different valency states were calculated from the van Vleck, Sommerfeld, Bose, and Stoner formula, $\chi_M = N\beta^2[4s(s+1)]/3kt$, and compared with the experimental values determined on a modified form of Gouy's balance. Chromium dioxide is shown to contain quadrivalent chromium, the constitution of a complex chromium sulphate has been confirmed, and silver chromate and the pyridine salt of the so-called blue perchromic acid (since shown by Schwarz and Giese to be a derivative of CrO_5 and not $HCrO_5$) have been shown to contain sexavalent chromium. The supposed sexavalency of chromium in triamminochromium tetroxide and its quinquevalency in pyridinium tetrachlorohydroxychromate, $C_5H_5N.CrCl_4.OH,H_2O$, and the analogous quinolinium salt have been controverted, more satisfactory constitutions being suggested. The three isomerides of dichloroaquotriamminochromic chloride have been examined from the magnetic standpoint. AUTHORS.

***4697. Magnetometer of Rogowski. G. Giorgi.** *Accad. Lincei, Atti*, 27. *pp.* 427–429, *May* 1, 1938.—Rogowski has proposed the measurement of the magnetomotive force *M* acting along a line PQ in the following way: Construct a flexible solenoid of very small section and arrange it with its axis in the line proposed; if the line must traverse magnetic material substances let there be bored through them a tunnel of very small diameter along the selected direction; then measure the electromotive impulsion that is induced in the solenoid when the whole magnetic field is reversed in sign; then this impulsion comes out proportional to *M*, the value of which is sought. The boring of the tunnel is theoretical, in practice the magnetic materials dealt with are not traversed by currents (macroscopically) across their mass, and consequently it is possible to operate along a line which connects the extremities themselves and extends into the air. This arrangement in the hands of able experimenters gives results sufficiently good and can frequently be employed in practice. Some investigators such as Kupfmüller and others have gone further and have approached conceptually to employing the arrangement to *define* magnetomotive force. This suggestion interests the author as the proceeding described is a continuation of his own work. The magnetomotive force *M* should not be defined as the integral of the lines of force H since the question then depends on H. The best direct definition, the author considers, is that related to energy, *i.e.* premises the notions of magnetic flux Φ and of magnetic induction *B*, arrived at electromagnetically and considered as a tube of flux having for axis the line PQ along which the value of *M* is desired. Then let δw be the elementary work which causes the increment of the flux by the amount $\delta\Phi$, and putting $\delta w = M/\delta\Phi$, *M* is defined, and it is more easy to derive H from *M* than *vice versa*. J. J. S.

***4698. Limiting Sensitivity of an A.C. Method of Measuring Small Magnetic Moments. E. A. Johnson.** *Rev. Sci. Instruments*, 9. *pp.* 263–266, *Sept.*, 1938.—A method of measuring the moment of small magnetic dipoles is described. The dipole to be measured is rotated inside a fixed coil, and the voltage induced in the coil is measured by means of an a.c. amplifier. The limiting sensitivity is computed from the calculated signal-voltage and the thermal agitation in the input circuit. In the practical application the theoretical sensitivity is approximately obtained and moments of 3×10^{-7} c.g.s. unit can be detected and with a specimen 1·5 cm. on a side 8×10^{-8} c.g.s. unit/cm^3. can be detected. The method has been applied to the measurement of the polarisation in sedimentary deposits. AUTHOR.

4699. Currents to Conductors Induced by a Moving Point Charge. W. Shockley. *J. of Applied Physics*, 9. *pp.* 635–636, *Oct.*, 1938.—General expressions are derived for the currents which flow in the external circuit connecting a system of conductors when a point charge is moving among the conductors. The results are applied to obtain explicit expressions for several cases of practical interest. AUTHOR.

4700. Change of Young's Modulus of Elasticity by Magnetisation in Iron and Carbon Steels. M. Yamamoto. *Tohoku Univ., Sci. Reports*, 27. *pp.* 115–136, *July*, 1938. *In English.*—The change of Young's modulus of elasticity by magnetisation in annealed Armco iron and various carbon steels was measured by the method of magnetostrictive oscillation. Main results obtained are as follows: Young's modulus of elasticity in these materials increases by magnetisation, and the amount of increase is of the order of 10^{-3}. The rate of increase is large in weak magnetic fields, and becomes gradually less as the field increases. For a given magnetic field, $\Delta E/E$ decreases continuously as carbon content increases. Akulov and Kondorsky's theory was confirmed for the total change of elasticity in Armco iron. AUTHOR.

4701. Mechanical and Magnetic After-Effect in Carbonyl Fe. G. Richter. *Ann. d. Physik*, 32. 8. *pp.* 683–700, *Aug.*, 1938.—A torsional after-effect is observed in carbonyl Fe which has the same temperature relation as the magnetic after-effect. In both cases the temperature effect is characterised by a Boltzmann factor $e^{-\theta/t}$ in which $\theta=10^4$. It is suggested that the two effects have a common origin which is briefly investigated. H. J. H. S.

See also Abstracts 4285, 4311, 4633, 4679.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***4702. Polyelectrophysiograph. O. L. Huddleston and R. W. Whitehead.** *Rev. Sci. Instruments*, 9. *pp.* 315–319, *Oct.*, 1938.—(1) The important characteristics of three groups of luminescent materials (phosphors) used in the construction of screens for kathode-ray tubes are described and some of the practical applications of these characteristics pointed out. (2) Some of the advantages and disadvantages of the "slow" screen tube, RCA 910, are discussed briefly and a description of the application of this tube to the study of heart sounds, or action currents from the heart and brain or peripheral nerves is made. (3) A method of erasing persistent phosphorescent tracings by means of exposing the tube screen to red light is presented. (4) The general arrangement of the "slow" screen and "fast" screen kathode-ray tubes together with some of the associated control equipment of the polyelectrophysiograph is described. This new laboratory instrument has proved extremely useful for both teaching and research. AUTHORS.

4703. Radiography of Sections. P. Roland. *Bull. de Photogrammétrie*, 81. *pp.* 1–38, *Jan.–March*, 1938.—This paper deals exhaustively with the geometrical conditions necessary for producing radiographs of one layer in a body. It is shown that, of the X-ray tube, body radiographed and photographic film, two must be moved in a related manner, and it is pointed out that in general the body cannot well be moved. Planigraphy and tomography are two of the possible systems. G. E. B.

4704. Advantages of Non-Screen Radiography. H. H. Duerr. *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 283–290, *Aug.*, 1938.—The use of X-ray intensifying screens is discussed historically and with respect to photomicrographs showing the relative grain sizes of the film emulsion and screen particles. The effect of grain is to spoil sharpness of the photographic image and omission of the screens is preferable for thick body parts, particularly as non-use of intensifying screens allows inspection of the X-ray film by means of a magnifying glass. Special films have been produced for use with the thicker body parts without intensifying screen, these films having a photographic speed five or six times that of the usual films. Examples of the use of this new type of film, with a table of exposure times are given. B. J. L.

***4705. Tomography. G. B. Bush.** *Brit. J. of Radiology*, 11. *pp.* 611–622, *Sept.*, 1938.—A description is given of a simple apparatus for the production of tomographs, which consists of an attachment to an X-ray couch by means of which a traverse of 10″ is given to a Bucky grid and a transverse movement to an X-ray tube working at a focus film distance of 36″. The "depth of cut" was tested by the method of Twining [see Abstract 2829 (1937)]. The definition obtained appears to depend on (1) smooth movement of tube and film with no back lash in the connecting mechanism; (2) use of fine focus tube; (3) a focus film distance of 36″; (4) perfect immobilisation of the patient and (5) tube shift at right angles to long axis of tube using line-focus. The accuracy of calibration and definition over an area of 12″ × 10″ was tested by means of a phantom of 5 sheets of wire netting separated by 1 inch. Radiographs are shown of the "cuts" made for each sheet. Finally it is not claimed that this apparatus using a simple traverse can produce all the results of that of Des Plantes in which the more elaborate mechanism produces a circular and spiral movement of the tube and film. T. A. C.

4706. Biological Experiments with a Condenser Discharge Type of X-Ray Tube. K. H. Kingdon, P. A. Zahl, C. P. Haskins and H. E. Tanis, Jr. *Radiology*, 31. *pp.* 52–58, *July*, 1938.—Biological experiments are described using a condenser discharge X-ray tube capable of delivering a dose of 3·5 roentgens in 5 μ.sec. Tests have been made of the validity of the Bunsen-Roscoe reciprocity law with eggs of *Drosophila melanogaster*, spores of *Aspergillus niger*, and wheat seedlings, a Coolidge tube operated at normal intensity being used as the source of radiation for the controls. No significant differences were found in the two sets of experiment, indicating the validity of the law over the range tested. Experiments have been made with the X-rayed material held in intense magnetic fields up to 23,000 oersteds, using the radiation from the Coolidge tube already mentioned, and the same biological materials. No appreciable effect of the magnetic field was found. Some implications of the work are considered. AUTHORS.

4707. How X-Rays May Kill Cells. H. Rudisill and J. H. Hoch. *Radiology*, 31. *pp.* 104–106, *July*, 1938.—A consideration of previous work indicates that the autocatalytic mechanisms governing the reduction-oxidation equilibria of the respiration of cells are affected by X-rays. The effect of X-rays on this system in the case of yeast cells was studied by determining the time necessary for the re-appearance of the cytochrome C absorption band (550 mμ) following irradiation and oxygenation. X-ray doses of from 3000 to 6000 r. cause an average initial increase in this re-appearance time of 225%. As it is known that X-rays produce nascent H and H_2O_2 from water it is suggested that the biological effects of the rays on cells may result from inactivation or destruction of cell respiratory mechanisms through the effect of these substances on the co-catalysts of the dehydrogenases. A number of well recognised biological effects of radiations are explained on this basis. J. E. R.

4708. Biophysical X-Ray Effect. K. Staunig and J. Löbering. *Kolloid Zeits.* 84. *pp.* 319–323, *Sept.*, 1938.—The hygroscopic absorption of fluid of animal tissues varies with the particular tissue and is modified if the tissue is submitted to X-rays, which may cause an increase or decrease of the maximum fluid absorption. It can be shown that the biological composition is not responsible for this variation but only the macro-molecular constitution of the preparation, the phenomena being analogous to changes in respect to viscosity. The effect is not reversible and is discussed in respect to the chemical composition and chemical chain formation. The effect is negative in carcinomatous change of the stomach tissue and apparently this is due to molecular change of the tissue and therefore offers a possible method of submicroscopical investigation of malignant tissues and new considerations in respect to X-ray therapy of cancer from electro-osmotic aspects. B. J. L.

4709. Grenz-Ray Therapy. Z. A. Leitner. *Brit. J. of Radiology,* 11. *pp.* 586–598, *Sept.*, 1938.—Grenz-rays are X-rays of wave-lengths between 1 and 3 Å produced at 6 to 12 kV in a tube with a very thin Lindemann glass window. The physical properties of these radiations are illustrated by means of curves showing spectral distribution, absorption in Al and absorption in skin. The latter shows that at 8 kV some 88% of the radiation is absorbed in the first 3mm. of tissue. The radiations are therefore generally used in the treatment of skin lesions, though they are reported to have a more general therapeutic application. The question of erythema production is discussed and considerable lack of agreement on the erythema dose is found among previous workers. A number of experiments have been carried out to determine this dose under various conditions and also the course of the erythema. Three waves of erythema are observed after a few hours, 10 days, and about 31 days, except in the case of small doses, and a distinct decrease in erythema dose with increasing kV is found. Curves are given showing the relation between dose and erythema, and it is found that these are similar to those for medium hard X-rays. J. E. R.

***4710. Dosage Chart for X-Ray Therapy. E. H. Quimby.** *Radiology*, 31. *pp.* 308–311, *Sept.*, 1938.—X-ray machines in U.S.A. are calibrated according to their output in air at some specified distance usually 50 cm. The International Committee for Radiological Units (Chicago 1937) made the additional recommendation that X-ray doses should be specified in terms of the numbers of röntgens delivered to the various skin fields. To obtain from calibration data, the number of röntgens delivered to the skin in a given time, or the time required for the administration of the number of röntgens delivered to the skin, it is necessary to have available a table of back-scatter values for any qualities of radiation and fields which may be used. Charts have now been devised for such purposes consisting of three sections: (*a*) parallel straight lines providing for the determination of röntgens/min. delivered in air, at any distance, within the range in which the inverse square law holds (*i.e.* from 10–15 cm. outside the tube up to any desired distance) and (*b*) parallel straight lines providing for the determination of the time necessary for the delivery of any specified number of röntgens in air, when the output of the machine in röntgens/min. is known, and (*c*) a third set of parallel straight lines for the determination of the time required to deliver a specified dose on a particular skin field, when the time for the dose in air is known. For the measurement of the back-scatter factors used in the construction of these charts, see Abstract 3030 (1938). As these may be modified when the tissue thicknesses are less than 10 cm., a table is now given of the correction factors, necessary for thin parts of the body. T. A. C.

4711. Effect of Filtration on Divergent Beams at Super-Voltages. H. S. Hayden, K. E. Corrigan and B. Cassen. *Radiology*, 31. *pp*. 312–318, *Sept*., 1938.—An account of experimental research on the effect of given filters in an X-ray beam generated at 500 kV, in order to find the best filter for therapy at this voltage. The theory is also developed. Conclusions reached include the following—an added filter in a beam of this radiation adds a component of hard scattered radiation to the beam and the quantity of scattered radiation is signficant; the quality of the filtered beam varies with the filter thickness and position and an improper filter may give a decreased depth dose. Filters were of Pb, with a secondary filter of Cu and Al to reduce the soft radiation, and diaphragms to control the effective beam. Curves and diagrams are reproduced. [See following Abstract.] E. H. W. B.

4712. Attenuation and Transition Effects in the Absorption of Supervoltage Radiation. B. Cassen, K. E. Corrigan and H. S. Hayden. *Radiology*, 31. *pp*. 319–324, *Sept*., 1938.—A theoretical analysis of scattering and filtering of X-ray beams is given, and its application to therapy. Heterogeneous X-ray beams generated at from 300 to 1000 kV are considered. [See preceding Abstract.] E. H. W. B.

4713. X-Ray and γ-Ray Protective Values of Building Materials. G. W. C. Kaye, W. Binks and G. E. Bell. *Brit. J. of Radiology*, 11. *pp*. 676–685, *Oct*., 1938.—Measurements of the lead equivalents of various building materials which may be used in providing protection for X-ray and radium workers have been made for X-rays excited at voltages up to 400 kV and for Ra γ-rays. The protective values increase with exciting voltage, reaching a maximum at about 100 kV, then fall to a minimum at about 200 kV and subsequently rise continuously. Protective values for X-rays excited at voltages up to 5,000 kV and for Ra γ-rays, have also been deduced, using theoretical and practical data relating to the energy distribution in X-ray and γ-ray spectra and to the photoelectric, scattering, and nuclear absorption processes. The satisfactory agreement between the experimental and computed values for X-rays excited at voltages between 200 and 400 kV and for Ra γ-rays suggests that the method can be applied to estimate the lead equivalent of a material at any voltage with an accuracy which is probably adequate for medical requirements. AUTHORS.

4714. Existence of a Critical Intensity. W. H. Love. *Brit. J. of Radiology*, 11. *pp.* 686–700, *Oct.*, 1938.—It has been found possible to make a complete analysis, based on recognised hypotheses, of the significance of radiation intensity in the determination of biological response. The analysis, which applies to any irradiated tissue, shows that the biological effect of a predetermined dose in a given tissue will, in general, be greatest for some particular value of the radiation intensity. The factors determining the existence of the critical intensity have been defined, and the evaluation of this intensity in any particular case is facilitated by several geometrical constructions and considerations. The relationship between the critical intensity and the radiation dose is briefly considered and attention is directed to the rôle of efficiency curves in the practice of radiation therapy. AUTHOR.

***4715. Development of H.V. X-Ray Tubes. C. C. Lauritsen.** *Radiology*, 31. *pp.* 354–361, *Sept.*, 1938.—An account is given of the development of a number of X-ray tubes working at voltages between 500 and 1200 kV at the California Institute of Technology. The most satisfactory tube has been used for therapeutic work at 900 kV*p* and 3 mA continuously since 1933. The tubes described were constructed of commercial glass cylinders and continuously evacuated. A porcelain tube is also described. The author goes on to discuss at length the relative merits of high and low voltages for clinical purposes. A detailed analysis of the problem of attenuation and true absorption shows that under normal clinical conditions percentage depth dose at 10 cm. should increase with *effective* voltage up to about 200 kV and then remain almost constant until well over 1000 kV. Thus there is some gain in increasing *tube* voltage up to 400 or 500 kV but no advantage from 500 to 1000 kV. If the dose at depths greater than 10 cm. is considered or if small beams are used there is a continuous increase above 500 kV. The question of a possible differential biological effect with wave-length is briefly considered. J. E. R.

***4716. Breakdown in X-Ray Tubes. N. C. Cordingly.** *Radiography*, 4. *pp.* 131–142, *Sept.*, 1938. A number of problems connected with the working of X-ray tubes and the precautions taken to deal with them are discussed. Manufacturing defects include loss of vacuum, inadequate degassing of metal parts, filament faults and insulation failures. Special consideration is given to the questions of reflected electronic bombardment and cold emission. Under working conditions breakdown of an X-ray tube may be due to destruction of the filament, caused by overheating or reverse emission, puncture of the glass envelope usually caused by excess voltage across the tube, failure of the anode cooling system, or overloading of the anode. In addition, the use of an excessive number of trial exposures, errors in screening technique, faulty instruments and short circuit of electrodes may lead to tube failure. A number of interlocked circuits designed to prevent some of the possible breakdowns are shown. J. E. R.

4717. Characteristics of X-Rays. J. L. Weatherwax. *Radiology*, 31. *pp.* 464–472, *Oct.*, 1938.—A useful outline for students taking a course in the Physics of Radiology, together with an extensive Bibliography covering a more complete survey of the subject.

***4718. γ-Ray and Neutron Generators and their Radiotherapeutic Possibilities. A. Bouwers.** *Radiology*, 31. *pp.* 89–93, *July*, 1938.—Experience gained in the design of h.v. generators for X-ray

production has been applied to investigations in nuclear physics. If a generator of 1MV is used for generating X-rays by accelerating electrons, reversal of the polarity will produce positive particles. Such positive particles can be produced in a tube with a perforated kathode, and are protons if the residual gas is H_2, deuterons in the case of D_2 and α-particles in He. Cascade tubes are described, suitable for 1MV, and generators for up to 4MV. A brief account of some applications is given.
E. H. W. B.

***4719. Recovery of Lost Radium. R. B. Taft.** *Radiology*, 31. *pp.* 340–344, *Sept.*, 1938.—The author has previously described [see Abstract 1843 (1937)] the Geiger-Müller counter for the detection of lost radium in medical applications. Further experiments are now described as to the distances at which this instrument is effective, experiments having been made in swimming pools and dust shoots. The instrument may be applied to detect, from the road, radium in the houses of operators, who may have stolen it, providing they have not taken the precaution to screen it.
B. J. L.

4720. Radium Protection. *Radiology*, 31. *pp.* 481–490, *Oct.*, 1938.—Contains the regulations set forth in the Revised Handbook, No. 18, of the National Bureau of Standards, incorporating the recommendations of the Advisory Committee on X-Ray and Radium Protection.

4721. Quantum Theory of Biological Processes. P. Jordan. *Naturwiss.* 26. *pp.* 537–545, *Aug.* 19, 1938.—The greater part of the paper is devoted to a historical survey of the quantum interpretations of biological processes, and in particular of the biological action of radiations. The theoretical and experimental work examined leads to the conclusion that a single quantum jump in a single molecule of a cell may influence the whole life function of the cell. It is then suggested that a gene is a single large molecule containing 10^4 to 10^6 atoms, a gene mutation resulting from a quantum change in this molecule.
J. E. R.

4722. Biological Effect of Kathode Rays. C. P. Haskins. *J. of Applied Physics*, 9. *pp.* 553–561, *Sept.*, 1938.—The paper opens with a theoretical discussion of the effect of X-rays and kathode rays on biological material, as a result of which it was decided to construct a kathode-ray tube suitable for work with biological material. The tube gives electron beams of high homogeneity at energies from 1 to 15 ekV and currents of the order of 10^{-9} to 10^{-7} A. Under such conditions the specimens themselves must be within the evacuated system. They are arranged on a rotating holder, which carries 28 specimens and which faces a slit in a specially designed "raying box" which is connected to the kathode-ray tube proper. This holder also carries a Faraday cage with a lead to a sensitive electrometer in order to allow for measurements of the intensity of the beams. Arrangements are also described for the study of cancerous material which cannot be placed *in vacuo*. Certain preliminary experiments with *aspergillus* and *penicillium* are described, particularly with reference to killing and mutation.
G. G.

See also Abstracts **4644** and
3254B. Method of Producing Intensive X-Ray Flashes. M. Steenbeck.
3255B. Radiological and Electro-Medical Apparatus. R. S. Whipple.

OSCILLATIONS AND WAVES.

4723. Fluctuations of an Auto-Oscillating System. I. Berstein. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 11–16, 1938. *In English.*—A mathematical investigation of the problem of fluctuations in an auto-oscillating system with one degree of freedom, the system approximating closely to a linear conservative one. A solution is obtained in general terms, and the spectrum of the oscillation determined. The general formulæ are then applied to the system of the dynatron oscillator, the diffuseness of the spectrum and the mean square of the amplitude fluctuations being estimated. J. P. A.

4724. Attenuation of Ultra-Short Radio Waves Along the Earth. S. R. Khastgir and M. K. Chakravarty. *Indian Journ. Phys.* 12. *pp.* 289–297, *Aug.*, 1938.—Relative field-strength was measured at different distances along a straight line over level earth from a portable ultra-short wave transmitter fitted with a quarter wave aerial. The transmitter was of sufficient power to enable field-strength measurements to be carried out with accuracy up to a distance of 50 m. from the transmitter. A wave-length of 3·64 m. was employed for the purpose. The receiver used was a heterodyne receiver with an oscillator-detector circuit followed by l.f. power amplification. The l.f. alternating voltage developed across the telephones in the output circuit, when the transmitter was on, was measured by a sensitive valve-voltmeter constructed for the purpose. Before any attenuation measurement was made, the frequency of the beat-note was adjusted whenever necessary, and brought in tune with the fixed note of a Galton whistle. All readings were taken through telescopes situated at some distance. The attenuation measurements have been examined in the light of Norton's formula for ground attenuation of radio waves from a short dipole aerial. The values of the electrical conductivity σ and dielectric constant ϵ of the ground which give agreement with Norton's formula are: $\epsilon=7$ e. s. u., $\sigma=0{\cdot}91\times10^{-14}$ e. m. u. The values for moist ground are however larger, *viz.*, $\epsilon=10$ e. s. u., $\sigma=1{\cdot}82\times10^{-14}$ e. m. u. It is significant that these values agreed in their orders of magnitude with the values obtained by the direct laboratory method. AUTHORS.

4725. Scattering of Radio Waves by the F-Region of the Ionosphere. H. G. Booker and H. W. Wells. *Terr. Mag.* 43. *pp.* 249–256, *Sept.*, 1938.—Records are reproduced showing diffuse echoes from the F-region of the ionosphere received continuously at night in equatorial regions over a wide range of wave-frequency. They are interpreted as due to Rayleigh scattering by spatial irregularities in the distribution of electron-density at or above a definite level in the F-region. Because of the highly dispersive nature of the ionosphere, there is no marked dependence of Rayleigh scattering upon wave-frequency such as there is for a non-dispersive medium. According to this interpretation, variation of the maximum wave-frequency to which diffuse echoes can be followed has nothing to do with variation of the maximum electron-density of an ionospheric region, but merely indicates variation in the size of irregularities in electron-density. Scattering of this type may have some bearing upon the phenomenon of persistence of E-region echoes to wave-frequencies greater than the critical penetration-frequency of the E-region. AUTHORS.

4726. Production of Ionospheric E- and F-Regions and Lower-Altitude Ionisation Causing Radio Fade-Outs. O. R. Wulf and L. S. Deming. *Terr. Mag.* 43. *pp.* 283–298, *Sept.*, 1938.—Ionisation responsible for radio fade-outs, not generally believed to be caused by u.v. solar radiation, presents an interesting problem particularly because of the relatively low altitude at which it occurs. It appears that the known E- and F-regions may be explained as arising from absorptions of solar radiation by atmospheric O_2 and N_2. Intense absorption by O_2 in the relatively near u.v. seems to give assurance that O_2 will first be encountered in appreciable amounts by incoming solar radiation in the vicinity of 100 km., the oxygen above this height being maintained in the atomic form by the dissociating action of the absorbed radiation. In the vicinity of 100 km. O_2 presumably sets in abruptly and rises rapidly to relatively high densities, leading to a narrow region within which all strong absorption by O_2, including ionising absorption, is confined. Dispersion-measurements in N_2 indicate two absorptions due to this gas in the far u.v., the positions of which are compared with spectroscopic data. These absorptions with two other absorptions due to O and N atoms produced by the primary molecular absorptions, are utilised in attempting to account for the normal ionosphere. The F-region is attributed to the nitrogen absorptions, and the E-region to the oxygen absorptions. It is concluded that the ionisation producing radio fade-outs probably cannot be due to a far u.v. radiation because of its remarkably low altitude and its intensity, and that such ionisation seems to require the presence of a new constituent, not present at greater heights, which possesses broad absorption in the near u.v. It is considered possible that radiation absorbed by O_3 produces this ionisation. A laboratory-experiment of some importance in this connection is suggested. AUTHORS.

4727. Effects Caused in the Ionosphere by Electric Waves. Part II. V. A. Bailey. *Phil. Mag.* 26. *pp.* 425–453, *Oct.*, 1938.—Following on Part I of a general investigation [see Abstract 2844 (1937)], the present publication contains a more complete study of resonance in gyro interaction, and shows that: 1. The resonance curves may have either one or two maxima depending on the height at which the auxiliary wave is reflected. 2. With an appropriate and simple aerial system observable interaction can be caused by radiating, in the form of a directed gyro wave, a power as low as 50 W. It is also shown that in latitudes distant from the equator an easily visible electric discharge can be produced in the ionosphere, at levels between 70 and 96 km. high, by means of a suitable aerial system radiating 500 kW of power in the form of a concentrated gyro wave, and that by increasing this power to 2×10^6 kW it is probable that at the least the minimum illumination 0·02 foot-candle prescribed for roadways would be produced over an area of about 10,000 km^2. AUTHOR.

4728. Ionosphere and its Influence on the Propagation of Electric Waves. W. Dieminger. *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 282–324, 1938.—After reviewing the various echo methods of investigating the upper layers of the ionosphere and discussing modern theories of the ionosphere and wave propagation, an account is given of the results obtained in numerous investigations including (*a*) normal effects, (*b*) abnormal phenomena and (*c*) the propagation of short, medium and long waves. It is concluded that the modern picture of the ionosphere obtained from numerous experimental and theoretical investigations is thoroughly established. The agreement between theory and observation is in many points very good and relations with other natural phenomena are in many cases in clear evidence, so that ionosphere investigation has now become an important branch of geophysics. Further knowledge is particularly desirable in the case of the phenomena of the F_2-layer and of abnormal effects. In this connection a considerable extension of our knowledge of certain solar and cosmic phenomena is to be expected. The theory of the ionosphere also needs modification in certain respects in order to obtain satisfactory agreement with observational results. For practical radio communication further investigation of the exact connection between the ionosphere and wave propagation is of the greatest interest, particularly with reference to the choice of wave-length best suited for different times and different distances. A. W.

See also Abstracts **4372, 4435, 4623, 4631, 4699,** and **3334B.** Electrical Resonator. W. W. Hansen.

PHOTOELECTRICITY.

4729. Time Lag in Gas-Filled Photoelectric Cells. A. M. Skellett. *J. of Applied Physics,* 9. *pp.* 631–634, *Oct.,* 1938.—Time lag measurements are described which were made with a light chopper on a gas-filled cell of special design. The resulting response *vs.* frequency characteristic curve exhibits the resonance oscillations predicted from theory and calculation of the lag from the positive ion mobility agrees with that determined from this curve. The construction of the cell is such that secondary emission and disintegration of the kathode by ion bombardment are eliminated even at high values of gas amplification. AUTHOR.

See also Abstracts **4292, 4331, 4563.**

PIEZOELECTRICITY.

See Abstract **4612.**

THERMIONICS.

4730. Thermionic Emission of Pt in H_2 and O_2. S. Kalandyk. *Acta Physica Polonica,* 7. 1. *pp.* 68–80, 1938. *In German.*—The variation with time of the negative emission from Pt in H_2 was investigated. It is found that a preliminary treatment with O_2 increases the thermionic activity considerably. At about 1400° C. a surface compound (perhaps PtH) is formed, the emission becoming independent of the H_2 pressure. With H_2 pressures in the region of 0·1 mm. Hg the emission is found to be proportional to the square of the pressure, but at lower pressures it is proportional to the pressure. The variation of emission with temperature was studied, and values for the work-function and the constant A in Richardson's equation were calculated. With D_2 in place of H_2 no essential differences were found. The absence of positive emission from Pt in H_2 was definitely established. The positive emission in O_2 was found to fall indefinitely with time. At constant temperature, the emission is proportional to p^z (p = pressure, z = constant which depends on the temperature). Values for the work function and the constant A are given. D. H. F.

4731. Electron Microscope Study of Thoriated Tungsten. A. J. Ahearn and J. A. Becker. *Phys. Rev.* 54. *pp.* 448–458, *Sept.* 15, 1938.—The behaviour of electron images of thoriated W ribbon is examined with the electron microscope; comparison with photomicrographs shows that the active and inactive patches which compose the electron image agree dimensionally with the exposed grains of W. The electron microscope shows that the Th comes to the surface in eruptions at a relatively small number of points located at random. It is also shown that all the Th in a globule comes to the surface when an eruption occurs. The frequency of eruption is affected by sudden heating or cooling of the filament and by high temperature flash. The eruptions are the only observed manner in which Th arrives at the filament surface and the factors which determine their arrival are briefly described. In a single crystal ribbon there is a strongly preferred direction of migration of the Th from the eruption centres whilst in a polycrystalline ribbon it is isotropic. The relative emission from different grains and the work function differences between them are described. H. J. H. S.

4732. Change of Electron Exit Work on Activation of Oxide Kathodes. W. Heinze and S. Wagener. *Zeits. f. Physik,* 110. 3–4, *pp.* 164–188, 1938.—The change of the electron exit work brought on at the activation by oxide kathodes was measured. It was found that the increase of the emission on activation is caused solely by a decrease of the exit work. The emission mechanism may be fully interpreted on the analogy of the emission equation established for pure metals: $i_s=AT^2\epsilon^{-\Psi_e/KT}$, in which the exit work Ψ_e is composed of an outer and an inner exit work. It is probable that only the internal exit work changes on activation. [See Abstract 1863 (1937).] J. J. S.

See also Abstracts 4365, 4582.

THERMOELECTRICITY.

***4733. Amplification of Thermo-E.M.F.s. R. Gunn.** *Rev. Sci. Instruments,* 9. *pp.* 267–269, *Sept.,* 1938.—Experiments employing a new type of regenerative d.c. amplifier have shown that such equipment is unsuited for use, except, perhaps, in the laboratory. A successful system of amplification employing valve amplifiers and commutators for inverting and synchronously rectifying the resulting amplified alternating potentials is described. Thermo-e.m.f.s less than 10^{-9} V are readily indicated on a portable microammeter. The over-all useful amplification with portable equipment exceeds 50,000. AUTHOR.

***4734. Tungsten Fuses. T. Utiyama and R. Arai.** *Electrot. Laborat. Tokyo, Japan, Circ. No.* 110. [42 *pp.*], 1938. *English Abstract.*—The tungsten fuses which are available on the market at present are studied with respect to fusing characteristics, comparison with various fuse metals, construction, range of rated current, short-circuit tests, insulation tests after the fuse is blown out, ageing characteristics, internal resistances, effects of the dimensions of lead wire and glass tube, coordination of fuse and loading, etc. The results of these investigations show that the most serious defect of the tungsten fuse is an irregularity of its fusing which is due to imperfect contact of the tungsten element and the lead wire, as they are only pressed together by hammering. If welded perfectly the characteristics of the tungsten fuse would no doubt be improved. The use of tungsten fuses makes the control of the over-load current much simpler and cheaper than with the current limiter. AUTHORS

See also Abstracts 4365, 4579.